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The use of differential VAT rates to promote changes in consumption and innovation

Final report

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Summary

This study deals with the likely impacts of differential VAT rates for specific products with recognised environmental benefits. Applying a reduced VAT rate to environmentally preferable products while taxing the less preferable ones at the standard rate could lead to a relative price reduction for the ‘greener’ product and thus stimulate the demand for this product. Likewise, increasing the VAT rate on environmentally harmful products that are currently taxed at a reduced rate might also steer demand and supply in a more sustainable direction.

The main research question was how producers, retailers and consumers would change their behaviour in response to the introduction of reduced VAT rates for ‘greener’ products and to the increase of reduced rates on ‘non-green’ products to the standard rate. This question has been addressed in various ways: through a literature survey, by reviewing experiences with previous and existing (environmentally motivated) VAT reduction and other subsidy schemes, and by directly contacting stakeholders. Five case studies have been carried out as illustrations and in-depth explorations of the posssible impacts. Interim results of ongoing parallel studies on related subjects have been taken into account.

General considerations

In general terms there are a number of considerations that deserve attention when considering the use of the VAT instrument for environmental purposes and assessing its potential impact. These include the following:

- Reduced VAT rates are usually applied for non-environmental reasons, such as distributional concerns, ‘public good’ (or ‘merit good’) arguments, or employment generation. These may either coincide (e.g. public transport) or conflict (e.g. meat, domestic energy) with the environmental motive.
- Application of reduced VAT rates requires a clear and unambiguous distinction between the qualifying ‘green’ products and their ‘non-green’ counterparts (e.g. on the basis of energy labelling or eco-labelling criteria).
- Due to continuous (eco-)innovations, products may cease to be the ‘greenest’ in their class after some time, and thus lose their eligibility for a reduced VAT rate.
- In competitive markets, VAT reduction is likely to be passed through fully to consumers (though this may take some time, especially in capital intensive sectors). Incomplete pass-through (or none at all) can be expected for products with high demand elasticities and if the VAT reduction is perceived as temporary.
- VAT differentiation (if passed through fully) will reduce the price of ‘greener’ products by some 10 to 15 percent. This may not always be enough to bridge the price gap with the ‘less green’ alternative. However, in the case of energy efficient products, the payback period will become shorter anyway.
- Data on the impact of relative price changes on the demand for ‘green’ and ‘less green’ products (cross price elasticities) are scarce. Moreover, such elasticities

should be applied with caution. Demand responses may differ between price increases and decreases, and between large and small price changes.

- For durable goods, the impact of VAT reduction will depend on (changes in) replacement patterns and on the question what happens with the replaced product (is it scrapped or does it remain in use).
- There is evidence for the existence of a ‘signalling effect’: subsidies and fiscal incentives, if properly communicated, tend to have an impact on consumer demand beyond the purely financial advantage they confer.
- The environmental impact of VAT differentiation should preferably be assessed for the product’s whole life cycle, using a ‘per unit of service’ approach, and taking into account indirect effects.
- The effectiveness of VAT reduction on energy efficient products may be somewhat reduced by behavioral changes (e.g. the ‘rebound effect’), but it is unlikely that these will offset the environmental benefits to any considerable extent.
- VAT reduction can stimulate the innovation dynamics in ‘green’ product markets, including learning curve effects and Porter-type competitive advantages. In this respect, there are no essential differences between VAT reduction and other instruments that that selectively stimulate demand and supply of ‘green’ products.
- If some Member States would opt for VAT differentiation whereas others would not, some increase in cross-border purchasing (e.g. of household appliances) is likely to occur, but this will be limited to border areas.
- As with other positive financial incentives, the phenomenon of ‘free riding’ (the incentive providing a windfall to consumers who were already buying the ‘green’ product anyway) cannot be avoided. Its size may be reduced, however, by a careful instrument specification and by applying it to products with high price elasticities.
- Expanding the scope of reduced VAT rates obviously implies a loss of public revenues. This may be compensated by a relatively small increase in the standard VAT rate, but other fiscal or budgetary measures are of course possible as well.
- The introduction of differential VAT rates within a product group will probably lead to legal disputes (borderline cases) and some fraud (attempts to sell non-eligible products under the low rate).
- Any change in the VAT regime will have wider economic consequences (on economic activity, employment, income distribution etc). Careful economic analysis can help to avoid unwanted impacts.
- The introduction of multiple VAT rates implies a non-negligible increase in the burden of administrative and compliance costs of the firms concerned.
- There are alternative instruments to VAT differentiation (e.g. direct subsidies, income tax credits) that may achieve similar results. These may avoid some of the VAT related problems (e.g. more freedom to determine the correct size of the incentive), but may also bring new complications (e.g. the need to set up a new administrative scheme, whereas VAT reduction can to a large extent lean on existing fiscal procedures). A comparison of VAT differentiation with other instruments is beyond the scope of this study.

Experiences in some EU Member States

A number of EU Member States already have some experience with using reduced VAT rates to promote environmentally preferred products. For example, from 1993 until 2004 the Czech Republic applied reduced VAT rates to a number of products including renewable energy equipment, biofuels and recycled paper. In Portugal, equipment necessary for the production and use of renewable energy resources is taxed at a 12% VAT rate (instead of 21%). Unfortunately, in both countries there is little evidence available that would allow to determine the impact of VAT reduction separately from the influence of other policy instruments. However, the general impression is that the role of VAT differentiation has been minor. In the case of Portugal, one of the reasons mentioned is that natural gas and electricity are still taxed at an even lower (5%) VAT rate.

In the UK a reduced VAT rate is applied to the (professional) installation of specific energy-saving materials. The uptake by paying customers (other than social housing and priority groups) has been low. One reason for this may be the fact that, since the installer buys the product for the final customer, the reduced VAT rate may not be clearly visible to the end consumer.

Case study: Central heating boilers

Almost half of the dwellings in Europe has a central heating boiler. The EU market amounts to some 6 to 8 million units per year, with a value of about € 8 billion (excluding the costs of installation). The size of the market (relative to population size) varies by Member State; it is relatively large in the UK, Ireland, the Netherlands and Italy. Until 2014, a moderate grwoth of the boiler market is expected (2% per year).

Condensing boilers (achieving an energy effciciency close to 100%) are obvious ‘green’ alternatives to traditional, ‘atmospheric’ boilers (but there are other energy efficient innovations as well, e.g. heat pumps and micro-CHP). The current average market share of condensing boilers is 44%, but differs widely between Member States (Denmark, the UK and the Netherlands having market shares over 80%).

Past experience with subsidy schemes for condensing boilers shows that they have a significant impact in terms of speeding up the growth in market uptake, but also that the share of ‘free riders’ tends to become high after some time. Reluctance among installers appears to be a main factor causing delays in market penetration.

Data for the Netherlands and the UK show that condensing boilers are on average 21 (NL) to 45 (UK) percent more expensive than traditional boilers (excluding installation costs). Applying the reduced VAT rate to condensing boilers could reduce this difference to 8 and 29 percent, respectively. For a representative household in these countries, this would reduce the payback period of the additional investment through energy savings from 2.2 to 1.2 years. Given past experience, this could lead to a short term increase in market share from 44 to 75% for condensing boilers.

The environmental impact of this increase (if the VAT reduction would be applied in all Member States) is estimated at 17.7 Mton of CO_2 reduction per year, or 4.5% of total CO_2 emissions from individual (gas fired) heating boilers in the EU. VAT revenues from the sales of central heating boilers would decrease by 55% (€ 676 mln).

In Member States where the market share of condensing boilers is already high, the VAT reduction would have a relatively low cost-effectiveness (due to a high rate of 'free riders'). In other Member States, regulatory instruments (such as the requirements of the EPBD directive) may stimulate the demand for condensing boilers and other energy efficient heating systems as well.

Case study: Household appliances ('white goods')

In this case study, four types of household appliances have been selected:

- Refrigerators;
- Washing machines;
- Dishwashers;
- Freezers.

Together, these appliances account for some 40% of household electricity use.

In the EU(-15), the market for refrigerators and washing machines is highly saturated (penetration rate close to 100%) and sales are mainly for replacement. For dishwashers and freezers the penetration rate is around 50% and these markets show a somewhat higher growth rate. The market for household appliances is dominated by a limited number of large producers; nevertheless there is stiff competition and real sales prices show a decreasing trend.

The rate of innovation in household appliances is high, and this includes a trend towards more energy efficient appliances. For the four product groups, it has taken just 5 to 9 years time for 'A' labelled types to capture a market share of more than 50%, and additional 'super-efficient' classes (A+ and A++) have been introduced for three of them. As with central heating boilers, the market share of energy efficient types differs widely between Member States.

Prices of household appliances show considerable variation. The most energy efficient models are usually (though not always) more expensive than the less efficient ones, but the price difference is not the same in all Member States. As a result, in some countries a reduced VAT rate could (more than) compensate the price difference, whereas in others (for the same appliances) it would not.

Given current appliance prices in the Netherlands, and average EU prices for electricity and water, a low VAT rate (if passed through fully) would reduce the price of 'A+' type refrigerators, freezers and washing machines to a level below that of the 'A' type.[1] For 'A++' type refrigerators and freezers, the payback period of the additional costs (compared to the 'A' type) would be reduced by 2 and 5 years, respectively.

Experience with a Dutch subsidy scheme for energy efficient 'white goods' suggests that a net price reduction between 10 and 20% may accelerate the uptake of these appliances. There is no empirical evidence for a 'relapse' to less efficient types after abolition of the financial incentive.

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[1] For dishwashers, no calculations could be done due to lack of data on A+ types.

It is estimated that a VAT reduction would move forward the market penetration of the eligible energy efficient types by 2 to 4 years, increasing their market share by some 15 percentage points. If applied EU wide, the VAT reduction would lead to a decrease in CO_2 emissions from the use of refrigerators, freezers and washing machines by about 3.4 Mton per year. The tax revenue loss would amount to some € 245 million.

Case study: Thermal insulation

Buildings are the largest single energy-using sector, accounting for 40% of Europe's energy consumption. Insulation is a highly cost-effective end-user measure in reducing the emissions of GHGs. Adding thermal insulation to existing buildings in the EU could potentially reduce the CO_2-emissions from heating by 42% (353 million tons per year). The largest potential for improvement lies in central and southern European countries.

Presently reduced VAT rates are in place for energy-saving building materials in the United Kingdom, and for renovation work in the housing sector (which may include thermal insulation) in a number of other Member States. The installation must be done by a professional or approved contractor.

In 2007, the thermal insulation market in Europe was worth € 30 billion. The market has shown considerable growth in the past few years, driven mainly by favourable building regulations and rising energy prices. A small number of large producers supply the materials. The actual product cost is just 10% of the overall market value; the installation service accounts for the largest part.

A reduced rate of VAT on thermal insulation is generally expected to enhance the demand for such products. It is considered to be a strong sales tool, if not a significant price incentive. The measure would apply to almost all housing and a significant share of the non-residential building stock. Its possible impact is illustrated by the results of a temporary campaign mimicking VAT exemption, which led to an increase in sales of 120%.

However, there are also some potential barriers to the VAT reduction's effectiveness. Indications exist that a reduced VAT rate on insulation products might not be passed through fully by installers to the consumers, although increased competition might force them to do so eventually. Furthermore, the reduced VAT rate may not always be clearly visible to the end consumer since the installer buys the product on his behalf. This is one reason why the uptake in part of the UK market has been low. In addition, capacity constraints and increasing production costs for insulation materials may counteract the price lowering effect of VAT reduction.

Depending on domestic energy prices, the 'payback period' of investments in thermal insulation ranges from 2 to 6 years. A reduced VAT rate would reduce this by a number of months. In addition to the financial incentive, consumer awareness is considered to be a crucial factor determining the investment decision.

The reduced rate of VAT, if applied EU-wide, is roughly estimated lead to 23 to 36 million tonnes of CO_2 reduction per year. VAT revenues would decrease by about € 3 billion.

It can be concluded from this case study that a reduced VAT rate for thermal insulation is a potentially effective instrument, but needs accomapying measures to remove market barriers and failures. It has relatively low administrative costs, but it is not sure that overall it would compare favorably to other types of incentives.

Case study: Domestic energy

Several EU Member States apply reduced VAT rates to energy products such as coal, heating oil, natural gas and electricity. EU wide, the VAT revenue foregone by not applying the standard VAT rate is estimated at € 2 billion for natural gas and € 5 billion for electricity, with the UK accounting for the largest part. These implicit energy subsidies are largely motivated by distributional concerns, although studies show that poorer households benefit less from them compared to richer households. Moreover, a low VAT rate on energy counteracts instruments like carbon/energy taxes and the emissions trading scheme, which have been introduced to reduce energy consumption.

This case study considers two policy options:

- increasing VAT on domestic energy to the standard rate in those Member States where it is currently taxed at a reduced rate;
- lowering VAT to the reduced rate for renewable sourced electricity where it is taxed at the standard rate.

Given existing estimates of the price elasticity of demand for domestic energy, it can be calculated that nearly 20 million tonnes of CO_2 could have been avoided in 2005 if the standard rate had been applied in the 10 Member States using the reduced VAT rates. The impact of the higher energy prices on low-income households could be alleviated by a targeted way of spending the additional VAT revenues, e.g. on energy efficiency programs.

Reduced rates of VAT on renewable sourced electricity are likely to reduce or close the price gap with conventional electricity, as it is expected that they would at least partly be passed throuigh to consumers. This would lead to an increased demand for ‘green’ electricity, but would do less to encourage energy efficiency. The CO_2 reduction that might be achieved by this measure EU-wide is estimated at 2.8 million tonnes.

Case study: Meat and dairy products

Most EU Member States currently apply a reduced VAT rate to food and food products, and some of them even a zero rate. This case study addressed the option of applying the standard VAT rate to dairy products, meat and meat products, with a possible exemption for organic production.

Meat and dairy production are economically important activities in the EU, with considerable environmental impacts. Food markets are highly competitive, though the food processing industry is dominated by a limited number of large firms, and some market power lies with the retail sector as well. The sales of meat and dairy products show substantial variation between Member States.

Organic agriculture performs environmentally better than conventional farming in a number of respects (though hardly in terms of GHG emissions), and is also advocated for various other reasons (e.g. animal welfare, food quality, health). The organic sector is developing strongly, but still accounts for only about 2% of EU food consumption. There are EU standardisation and certification schemes for organic agriculture, providing a clear and unambiguous means of distinguishing between organic and conventionally produced meat and dairy products.

Organic food is more expensive to produce than conventional food, and therefore sells at a premium to conventional produce. There are wide variations in price premiums between Member States. In countries where general food shops are active in the marketing of organic food, price premiums are usually lower than in countries where organic food shops or direct sales provide the main channels.

VAT measures in the meat and dairy sector are generally expected to be fully passed through to the consumer. The effect of requiring meat and dairy products to be taxed at the standard rate would be to increase their price by between 0% and 21%, depending on their current VAT treatment in different Member States. Adjusting for market size produces a weighted average increase in prices of 12% across the EU. If VAT on organic meat and dairy products was kept at reduced rates, this would help to reduce the price differential between organic and conventional produce, though the price change would not be large enough to close the substantial premium that persists for most meat and dairy products in most Member States.

Demand for meat and dairy products is price inelastic. Overall, evidence suggests price elasticities in the range -0.2 to -0.6 for meat and of -0.2 to -0.4 for dairy products. Based on these elasticities, a 12% price increase would be expected to reduce demand for meat in the EU between 2% and 7%, and for dairy products between 2% and 5%. This could bring about a gross reduction in greenhouse gas emissions of between 9.2 and 27.5 million tonnes CO_2 equivalent for meat and between 3.4 and 6.9 million tonnes CO_2 equivalent for dairy products. Other environmental benefits of reduced consumption would include reductions in eutrophication and acidification, and reduced pressure on land use.

EU evidence suggests a cross price elasticity somewhere between 0.5 and 1.3 for organic meat and dairy products; i.e. a 1% increase in the price of the conventional product increases demand for the organic product by 0.5 to 1.3%. On this basis a 12% increase in the price of conventional produce could boost demand for organic meat and dairy products by between 6% and 16%. This substitution would not be expected to reduce GHG emissions but could bring a variety of benefits in terms of biodiversity, landscape and reductions in water pollution.

A VAT change could be expected to have a range of wider impacts, both positive and negative. It could yield health benefits, particularly if accompanied by educational activity. On the other hand, lower income consumers would probably have difficulty in adjusting their diet in response to a price change and there might be a shift towards cheaper product types. The measure would be unpopular with farmers, many of whom are already struggling to compete in a more competitive market place. There would be strong political resistance to a VAT increase, on the grounds that it is taxing basic needs and amounts to government interference in the dietary and lifestyle choices of individual consumers.

Any such move should be accompanied by a wider awareness raising and educational campaign, promoting the health as well as the environmental benefits of consuming less meat. Given low consumer awareness of the issue, it is likely that the VAT change will be as important in its signalling effect as in its price effect.

This VAT change would also generate significant revenue and represent a tax harmonising measure (though it would introduce differences in VAT treatment of meat and other food products).

Conclusions

The conclusions firstly focus on the three groups of stakeholders that we distinguished (producers/importers, retailers/installers, and consumers). Next, the environmental impact is discussed and some general issues are addressed.

Producers and importers

Current producers of the 'greener', 'low-VAT' products will see their market share growing at the expense of those who are specilized in supplying the 'less green' ones. This implies a shift in market share in favour of the first group, but the latter may also benefit by responding adequately. The most innovative firms will develop new and still 'greener' products, considering the prospect of obtaining a strong market position in the future when the criteria for VAT reduction will be tightened.

The case studies tend to confirm that VAT differentiation is expected to be one of the factors having an impact on innovative activity, though its role will differ by type of product and market.

Retailers and installers

The evidence on the extent to which reduced VAT rates are 'passed through' to the final consumers, and thus lead to proportionally lower product prices, is mixed. Empirical evidence as well as expectations among stakeholders show examples of complete as well as of incomplete 'pass-through'. Lack of competition and the prospect of the VAT reduction being temporary are among the factors precluding full 'pass-through'.

The impact of VAT differentiation is expected to go beyond the financial incentive it provides, as it is expected to be used as a communication and marketing tool. For products which are usually installed by professionals, the effectiveness of a reduced VAT rate can be enhanced by applying the reduced rate not just to the product, but to the installation service as well. In some sectors, conservatism among retailers and installers may be an important obstacle, underlining the need for accompanying promotional measures, specifically targeted at retailers and installers.

Consumers

Consumer response to price changes resulting from VAT differentiation will vary between types of products, depending on elasticity of demand. Full 'pass-through' implies a price change in the order of 10%. For meat, dairy and domestic energy (products with low elasticity of demand) this would lead to a change in demand of (much) less than 10%. On the other hand, evidence shows that in some cases the 'substitution elasticity' between 'green' and 'non-green' products within one product group may be much larger. Data on elasticities are scarce anyway, and they should be treated with caution. In dynamic markets with high innovation rates, the impact of VAT reduction will mainly be to move forward the market penetration of the ‘newest and greenest’ models.

In many cases, VAT reduction may not be sufficient to bridge the ‘price gap’ between the ‘green’ and the ‘non-green’ product. However, for energy efficient goods it will reduce the ‘payback’ time and thus make them more attractive. Apart from its financial impact, a reduced VAT rate is expected to play a ‘signalling’ role by drawing consumers’ attention to the eligible products.

As with any subsidy scheme, reduced VAT rates will also benefit those consumers who would have bought the ‘green’ product anyway (‘free riders’). Minimizing ‘free riding’ in dynamic markets requires a frequent updating of eligibility criteria so that only the ‘top of the market’ qualifies.

Due to the variety in markets for ‘green goods’ between EU Member States, a uniform EU wide VAT differentiation might stimulate the growth of the ‘green’ market in some countries, whereas it would be hardly effective (and bring along a lot of ‘free riding) in others. This effect could be mitigated by allowing Member States to choose whether or not they want to apply the VAT differentiation for specific product groups. Alternatively, the criteria for reduced VAT eligibility could be differentiated by Member State, though this would add to the complexity of the scheme.

Environmental impact

VAT differentiation may bring about significant environmental benefits in some product categories. Table S.1 shows some estimates from the case studies for greenhouse gas emissions, but there are of course other environmental benefits as well.

Table S.1:Estimated greenhouse gas emission reductions due to VAT differentiation in selected cases (Mt CO_2 equivalents per year)

Product category	**GHG emission reduction (Mt CO_2-eq. per year)**
Central heating boilers	18
Refrigerators, freezers and washing machines	3
Insulation materials	23 – 36
Domestic energy (applying standard rate)	20
Domestic energy (reduced rate for renewables-based electricity)	3
Meat and dairy (applying standard rate)	12 – 21

These estimates should only be seen as an illustration of the orders of magnitude. A complete analysis should address aspects such as:

- impacts over the product’s whole life cycle;
- calculate impacts on a ‘per unit of service’ basis;
- interactions between the product categories;
- the ‘rebound’ effect (though this is likely to be small);
- the question what happens with the ‘old’, ‘non-green’ product when it is replaced by a ‘green’ one.

Other considerations

The acceptance of VAT differentiation as an instrument to promote 'greener' products appears to vary widely. A majority of stakeholders consulted in the case studies tends to support reduced VAT rates for 'green' products, if properly designed and accompanied by supporting measures. There seems to be much less support for an increase in VAT rates on domestic energy, meat and dairy products to the standard level (in countries currently applying a reduced rate).

For the product groups considered in the case studies, no major problems are expected with respect to definitions and criteria for VAT differentiation.

Though VAT differentiation implies higher administrative and compliance costs, its advantage over many other targeted subsidy schemes is that the basic administrative structure is already in place.

Introducing reduced VAT rates for 'greener' products will lead to lower tax revenues, which can be compensated by a relatively small general increase in VAT rates or by other measures. Furthermore, differential tax rates may create an incentive for tax evasion, implying lower tax revenues and higher costs of checks and inspections. Differences in VAT rates between Member States will induce cross-border sales, affecting national tax revenues, although the impact at the overall EU level may be neutral.

A possible VAT differentiation will be just one among several measures of a sustainable production and consumption policy. Its effectiveness will therefore to a large extent be determined by the other elements of the package. These policies are only partially harmonised at EU level, and this is an additional reason why the impact of environmental VAT differentiation will differ between Member States.

Introduction

The European Union aims at a more intensive use of market based instruments (MBIs) in environmental policy. This has been laid down in policy documents such as the Sixth Environment Action programme, the renewed EU Sustainable Development Strategy and the Lisbon Strategy. The European Commission has confirmed its ambition to promote MBIs in a recent Green Paper.[2]

A specific type of MBI is the use of differential rates in general taxes, so as to stimulate the supply and use of relatively environmentally benign alternatives within a certain group of products or services. In the past, such tax differentiations have been successfully applied in Member States to promote e.g. catalytic converters in cars, unleaded petrol and low-sulphur fuels.

Another general tax that could be used for environmental purposes is the Value Added Tax (VAT). The EU's current (partially harmonised) VAT system, governed by Directive 2006/112/EC, provides for a standard rate of no less than 15%, and one or two reduced rates of no less than 5%. The rates currently applied in the Member States vary between 15 and 25% for the standard rate, and between 5 and 13.5% for the (lowest) reduced rate.[3]

The main aim of the present study was to understand the likely impacts of differential VAT rates for specific products with recognised environmental benefits. This will help to understand the extent to which differentiation can be expected to provide environmental benefits, the type and scale of any resulting costs, and the degree to which these costs are likely to be proportionate to the benefits. The study also had to analyse the impact of ending low VAT rates for environmentally damaging products.

Applying a reduced VAT rate to environmentally preferable products while taxing the less preferable ones at the standard rate could lead to a relative price reduction for the 'green' product in the order of magnitude of 10% (assuming that the supplier passes the financial benefit on to the customer).[4] The impact of VAT differentiation will mainly depend on three groups of stakeholders: producers (including importers), retailers, and consumers. The main question to be addressed in this study was therefore how these three groups would change their behaviour in response to the introduction of reduced VAT rates for 'greener' products and to the increase of reduced rates on 'non-green' products to the standard rate.

The information needed to answer this question has been collected in various ways. A survey was made of relevant existing studies and of experiences with environmentally motivated VAT differentiation in practice. In addition, a number of case studies were

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2 COM(2007) 140 final.

3 Ignoring 'super reduced' and zero rates, which are subject to specific provisions, as well as several derogations for individual Member States.

4 By its nature, the VAT instrument is only effective for consumer goods and other 'final demand', as VAT paid on transactions within the value chain is refundable (leaving aside the special cases, such as farmers who can 'opt out' of the VAT regime).

carried out, analysing for five product groups the main factors that would influence the impact of VAT differentiation, their relative importance and the magnitude of the impacts that can be expected. For these case studies, market data and expert views from the different stakeholder groups were collected for different Member States.

The present report contains the findings of the study. Chapter 1 discusses some general considerations and contains a short survey of existing literature on the subject. Chapter 2 present a selection of experiences with past and existing schemes that use reduced VAT rates to stimulate ‘green’ purchasing. Chapter 3 through 7 present the findings from the case studies: central heating boilers (3); household appliances (‘white goods’) (4); thermal insulation products (5); domestic energy (6); and meat and dairy products (7). Chapter 8 contains the conclusions.

1. VAT differentiation as an environmental policy instrument: general considerations and evidence from literature

1.1 Introduction

In this chapter, we present some general considerations that are likely to be relevant in the discussion on using reduced VAT rates to promote the market penetration of 'greener' goods and services.

1.2 Motives for using reduced VAT rates

The primary reason for many countries to apply two (or more) VAT rates has to do with distributional considerations. A uniform VAT rate is supposed to have a regressive impact, because low-income households tend to spend a larger share of their income on basic consumption and less on luxuries and on savings than higher income households. Applying a lower VAT rate to 'basic needs' such as food might neutralize or reduce this regressive impact.[5]

A second main reason for rate differentiation is the 'public good' (and/or 'merit good') argument. Authorities want to encourage people to buy products and services which have 'positive external effects', or which are (according to the authorities) good for them (in terms of, for instance, health, education and culture). Thus, many countries apply reduced VAT rates to public transport services, education, medical services, pharmaceuticals, books and/or theatre tickets. Within this line of argument, reduced VAT rates for environmentally benign products can be motivated by the fact that they convey more positive (or rather: less negative) external effects than their less 'green' alternatives.

Obviously, these two main motives may counteract or reinforce each other, depending on the product category. For example, a low VAT rate for public transport may also be seen as environmentally desirable[6] , whereas this is not the case for low rates applied to energy, water or meat. In some cases one motive may be used to help to counteract any perverse incentive created by the other – for example, VAT may be reduced on energy saving materials to help to offset the incentive effects of a VAT reduction in domestic energy, the latter applied for social reasons – in this case it would appear to be perverse from an environmental perspective to tax energy use at lower rates than energy conservation.

Employment generation, transferring work from the 'informal' to the 'formal' economy, and the struggle against 'black' economic activities are a third set of motives behind

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5 To what extent reduced VAT rates on such product groups actually 'benefit the poor' is questionable, however (see e.g. OECD, 1998).

6 To the extent that it stimulates a shift from car use to public transport. However, a low VAT rate on public transport may also increase the total demand for transport and stimulate a shift away from even less polluting transport modes (walking, cycling).

VAT reduction. These have played an important role in the introduction of the opportunity to apply (until 2010) reduced rates to certain labour-intensive services, as provided for in Article 106 and Annex IV of Directive 2006/112/EC. Here again, there may be synergy with the environmental motive (e.g. in the case of bicycle, shoe and clothing repairs), but this is not necessarily the case.

1.3 Effectiveness of reduced VAT rates

The purpose of environmentally motivated VAT reductions is to provide a price incentive to boost the sales of 'green' products, at the expense of their 'less green' or 'non-green' alternatives. The effectiveness of this mechanism depends on a number of assumptions and conditions, which may not always be fulfilled.

1.3.1 The distinction between 'green' and 'non-green' products in a dynamic market

The need for a clear distinction criterion between the 'green' products (entitled to a reduced VAT rate) and their 'non-green' counterparts (subject to the standard rate) is obvious. This limits the applicability of environmentally motivated VAT differentiation to those product groups for which such criteria exist (or can be created), preferably as an EU-wide standard. The existing energy labelling scheme for household appliances and cars as well as the EU's eco-label may be clear candidates to provide the necessary criteria. These schemes, however, do not (yet) apply to the whole range of consumer goods. Moreover, standards for eco-labelling are 'dynamic' (i.e., the requirements become more stringent over time), and a dynamisation of the energy labelling schemes is also foreseen. This would imply that products that qualify for a low VAT today might not do so tomorrow.[7] For other product categories, however, this 'dynamic' aspect does not apply, as they are 'green by nature' (e.g. insulation materials).

Even if standardized criteria are available, their correct application has to be monitored and enforced. The distinction may also be complicated by borderline cases and 'mixed products' (see below).

1.3.2 Passing through the lower rate in sales prices

According to the Copenhagen Economics (2007) report, there is little doubt that permanently lowering the VAT rate on a particular good (or service) sooner or later will lead to a reduction in the price of the good more or less corresponding to the monetary equivalent of the lower VAT rate. In economics jargon, there will be a strong tendency towards full pass-through. The study mentions (in Section 2.3) two examples as empirical evidence. A rise in the VAT rate on periodicals of 10 percentage points in Italy in 2002 led

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7 A good example of a fiscal incentive with frequent updating of eligible 'green' technologies is the Dutch MIA/VAMIL scheme. Innovative technologies that qualify for this incentive are on a list ('Milieulijst') which is updated annually. Between 2000 and 2005, 382 (out of 498) technologies were removed from the list, and 112 new technologies were added. The MIA/VAMIL scheme is considered to be operating effectively and efficiently (Ministerie van VROM, 2007).

to a rise of prices of 14 percent, and a reduction in the VAT rate on books in Sweden of 19 percentage points in 2001 led to a fall in book prices of 12 percent (see Figure 1.1). This corresponds to a pass-through to prices of 134 and 80 percent respectively. Given the uncertainty involved in the estimations this is considered to be close to a full pass-through.[8]

However, the same study also notes that in sectors with limited competition, pass-through to prices may be less than full. If the price initially has been set at a high monopolistic level, firms are not likely to adjust the price downwards to the full extent of VAT reduction, but will re-optimise in order to maximise profits, typically leading to a pass-through that is less than full. Furthermore, the Copenhagen Economics study states that the pass-through will be relatively slow in sectors with high capital intensity as it takes longer for firms to adjust capacity to changes in demand. Pass-through to prices will generally be lower when demand elasticity is high. Finally, the study concludes that producers are unlikely to respond strongly to VAT rate changes if they are perceived to be only temporary (as is the case with the current exemptions for certain labour-intensive services).[9]

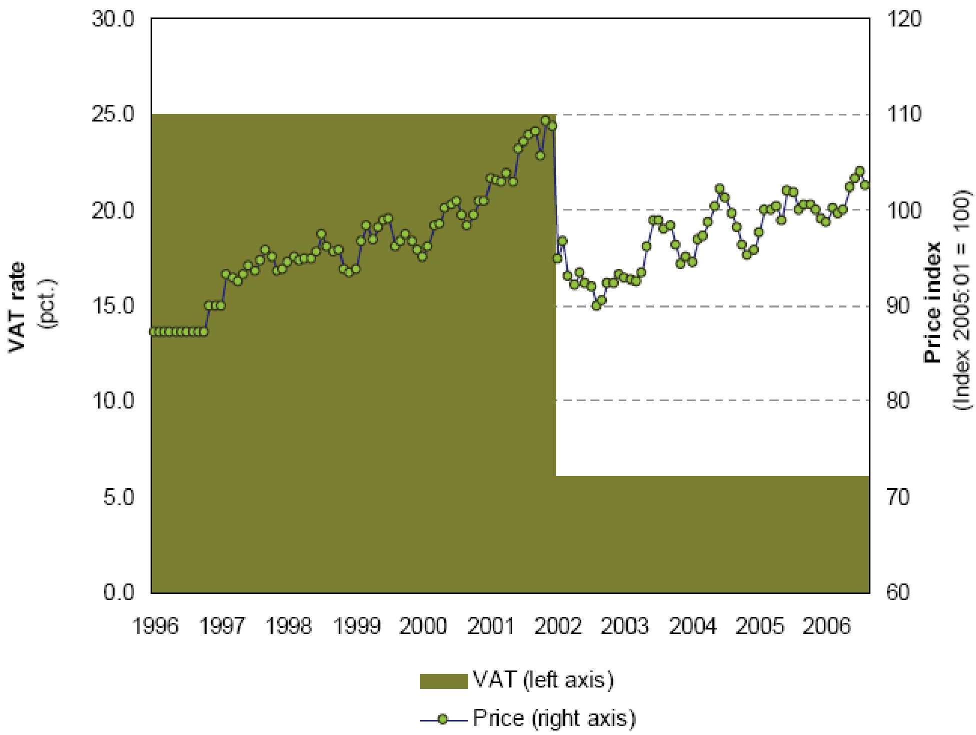

Figure 1.1. Pass-through of VAT reduction: the example of books in Sweden (reduction from 25 to 6% in 2002). Source: Copenhagen Economics (2007), Appendix II.

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[8] One might add that in addition to uncertainty in the estimates there are probably also other factors affecting prices over time, preventing the price change from matching the VAT rate change exactly.

[9] Appendix I to the Copenhagen Economics study contains a number of literature sources on the pass-through of VAT rate changes.

1.3.3 Size of price reduction

By its very nature, VAT differentiation (even if passed through fully) will only lead to limited price changes. In most EU Member States, the difference between the standard and the reduced VAT rate is between 10 and 15 percentage points. If the initial price difference between the 'green' and the 'less green' product was larger than that, the 'green' product will remain more expensive, even if it is subject to a reduced VAT rate. However the difference will become smaller in any case, and to the extent that energy efficient products are concerned, the payback period (i.e. the time it takes before the additional purchase price has been earned back through lower energy bills) will become shorter.

1.3.4 Elasticity of demand

The impact of lower prices (caused by lower VAT rates or by any other cause, for that matter) will depend on the shift in consumer demand it brings about. This is expressed in the 'own price elasticity of demand': the percentage change in demand for a product in response to a 1% change in the price of that product. Basic goods, such as food, typically have a low elasticity of demand (less than 1 in absolute terms).

In the context of the present study, we are especially interested in the substitution between 'non-green' and 'green' products within the same product group. In this respect, another relevant parameter is the 'cross elasticity of demand', i.e. the percentage by which the demand for one product changes in response to a 1% price change in another specific product.

Studies carried out in the framework of the Copenhagen Economics (2007) report reveal an asymmetric price response: increases in VAT rates have a stronger and faster response on prices than decreases. The literature review in the Appendix to the same report suggests that consumer behaviour cannot be summarised in a single elasticity parameter (or function). In fact, consumers may respond to price changes in disruptive manners due to psychological factors. As a result, the response to large price changes can be much stronger than to small price changes.

Price elasticities relevant for environmentally motivated taxes have mainly been estimated in the areas of energy and transport. A recent OECD (2006) report contains a summary of such estimates. These are mainly own price elasticities; cross price elasticity estimates are largely confined to the area of motor fuels (e.g. leaded versus unleaded petrol and high versus low sulphur diesel). Some data on cross price elasticities is also available for organic versus conventional foods (cf. Chapter 7 in the present report).

1.3.5 Product life cycles and replacement patterns

The impact of VAT differentiation will differ between different kinds of product groups. An important distinction is between durable and non-durable goods. Whereas the demand for non-durable goods (such as food and fuels) can (in principle) shift instantaneously to the 'green' alternative in response to VAT reduction, the demand response will be slower in the case of durable goods. Within the latter category, the average life span of the product matters. In highly dynamic, unsaturated markets for innovative products (such as the markets for ICT products) life spans are much shorter than in saturated markets (such as those for 'white goods'[10]). Nevertheless, in the latter case a VAT reduction may accelerate the replacement rate.

The literature on the life span of durable consumer goods focuses mostly on the determinants of purchasing decisions and replacement patterns (see e.g. Fernandez, 2001; Young, 2008). For an analysis of the impact of VAT differentiation these studies are of limited use.

The net environmental impact of replacing an old, eco-inefficient appliance by a new, 'greener' one depends not only on the difference in environmental performance of both appliances, but also on the question what happens with the 'old' one. The impact will be more positive if the discarded appliance is scrapped than if it continues to be used somehow (either as a 'second' appliance in the same household, or by another user, within or outside the EU, after being sold on the second hand market).

1.3.6 The 'signalling' effect

It is conceivable that the impact of VAT reduction is not restricted to the financial incentive it provides. Applying a low VAT rate on particular products could also be regarded as a 'seal of approval' by the authorities, indicating that the consumer is 'doing the right thing' when buying it.

This 'signalling effect' may already occur in the stage when the proposal for the tax incentive is publicly being discussed (Ekins, 1999). This type of signalling effect, also called an 'announcement effect', has been observed with the British Climate Change Levy (Agnolucci *et al.*, 2004).

An illustration of the 'signalling effect' is given by Sammer and Wüstenhagen (2006), who found that consumers in Switzerland are prepared to pay a price premium for energy efficient, 'A' labelled washing machines that exceeds the cost savings that can be expected over the lifetime of the product.

A strong indication for the existence of a 'signalling effect' at the producer's side was found by Aalbers *et al.* (2007). They evaluated the impact of technology adoption subsidies on investment behaviour in an individual choice experiment. In a laboratory setting professional managers were confronted with an intertemporal decision problem in which they had to decide whether or not to search for, and possibly adopt, a new technology. Technologies differed in the per-period benefits they yield, and their purchase price increased with the per-period benefits provided. A subsidy was introduced on the more expensive technologies (that also yield the larger per-period benefits), and the authors found that the subsidy scheme induces agents to search for and adopt these more expensive technologies even though the subsidy itself is too small to render these technologies profitable. According to Aalbers *et al.*, the result might be driven by the positive connotation that the concept 'subsidy' invokes.

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[10] For example, Young (2008) found that in Canada over 40% of the freezers remain in use for more than 20 years before being retired.

1.3.7 Marketing

The traditional 'marketing mix' consists of manipulating the 'four P's' (product, price, place and promotion). Clearly, VAT differentiation is primarily aimed at influencing the price. However, by providing incentives for innovation (see section 1.4.3) it will also affect the product. Promotion is yet another element in the marketing mix that may contribute to the success of the instrument.

As indicated in the previous section, a product's eligibility for VAT reduction can be seen as a kind of label that distinguishes it from competing products. This offers opportunities for retailers to promote it, using this additional distinctive feature. However, there are some considerations that limit the potential of 'reduced VAT' as an additional 'green marketing tool'.

Firstly, as noted in section 1.3.1, a prerequisite for applying VAT differentiation is the presence of objective criteria that distinguish eligible from non-eligible products. If these criteria are visible, e.g. by means of an energy label or an eco-label, these would already themselves offer the opportunity to be used as a marketing tool and the reduced VAT rate would not add more distinction.

Secondly, one should always keep in mind that the market for 'green' products is essentially a niche market. Even though many consumers say they are prepared to pay more for such products, only a very small part of them actually does so (that is, paying more for a product that is 'greener' but otherwise identical) (see e.g. Prakash, 2002). For a 'green' product to reach the mass market, it has to be attractive to the consumer for other reasons (lower price, lower life cycle costs, better quality, performance, design etc.). Marketing campaigns which only emphasise the 'greenness' of a new product are unlikely to achieve a substantial growth in market share (see e.g. Polonsky and Rosenberger, 2001). The marketing efforts will have to highlight other features that distinguish it from its competitors. Obviously, a lower price (due to the reduced VAT rate) may be one of these features.

1.3.8 Environmental impacts

The environmental impact of a shift in demand towards 'greener' products depends, in the first place, on the intrinsic environmental properties of the 'green' product, compared to its 'non-green' counterpart. For a complete analysis, it is important not only to look at the impact in the use stage (e.g. energy consumption), but also at impacts in other stages of the product's life cycle. Furthermore, the impacts should preferably be calculated on a 'per unit of service' basis, so as to control for differences in performance. Life cycle analyses (LCAs) can be a helpful tool. Finally, the overall environmental impact will also depend on the way in which consumers use the product (e.g. the 'rebound effect; see Section 1.4.1).

1.4 Indirect effects

1.4.1 The ‘rebound’ effect

Reducing the rate of VAT on relatively energy efficient products may have a number of side effects that could undo (at least partly) the energy savings it was intended to promote. These side effects are often referred to as the ‘rebound effect’.

The VAT reduction may reduce the average price of products within the product group relative to other consumer goods. If the product group as a whole is relatively energy intensive (the Copenhagen Economics (2007) report mentions the example of hairdryers), the resulting shift in consumption may lead to an increase in energy use. However, the validity of this argument seems to be limited. If the energy efficient variety of the product was more expensive (before the VAT reduction) than the ‘non-green’ alternative, then the VAT reduction will probably only lead to a shift in demand within the product group towards the energy efficient product. Only in the (exceptional) case where the ‘green’ product was already less expensive than the ‘non-green’ one, a VAT reduction could also lead to an increase in demand for the entire product group.

The ‘rebound effect’ can also be interpreted in a wider sense, indicating the behavioural changes that occur in response to the net price decrease of energy services that is the result of gains in energy efficiency and that offset these gains to some extent. Greening *et al.* (2000) compiled a review of studies addressing the ‘rebound effect’ in energy efficiency policy in the USA. They concluded that estimates of the rebound are very low to moderate. The upper estimates indicated a rebound effect that was not insignificant, but also not so high that most or all of any reductions in energy use or carbon emissions would be lost to changes in behaviour.

1.4.2 Impact on the ‘non-green’ product market

A VAT rate reduction for ‘green’ products may not only lead to price reductions of these products themselves, but also of their ‘non-green’ rivals. The reason is that suppliers of these ‘non-green’ products will try to maintain their market share and lower their prices (and profit margins). This potential impact (noted in CECED, 2007a) would reduce the net relative price decrease resulting from the lower VAT rate. However, it seems likely that this will be a temporary phenomenon, as product supply will after some time adjust to the new tax rates, and suppliers will not be able to operate at low (or even zero or negative) margins for a longer period.

1.4.3 Innovation and market transformation

Even where short term price effects are limited, lower VAT rates will have a dynamic effect in stimulating innovation and encouraging the supply of greener products. This impact is of course not a unique feature of VAT differentiation, but can be expected in all situations where policy measures create market incentives for such products.

Newly developed products tend to be relatively expensive in the early stages of market deployment. Growing demand can drive down the production costs (the ‘learning curve’ effect; see e.g. Junginger, 2005) and thus lead to price reductions. In principle, a reduced

VAT rate could contribute to this process by narrowing the price gap between the new, 'greener' product and the 'standard' alternative and thus accelerate the growth in demand for the 'greener' one. However, this contribution is likely to be small in the early stages of the product's life cycle, when the price difference is often much larger than the average of around 10% between the standard and the reduced VAT rate. Nevertheless, the innovative firm offering products that are eligible to the reduced VAT rate will see his sales figures increasing, if he passes the VAT rebate through to the customer. If the market situation allows him to refrain from pass-through, the profit margin on the innovative product increases. In both cases there is a market incentive for innovation.

Fiscal incentives such as VAT differentiation are just one among several factors that determine the diffusion of innovative, 'greener' consumer products. Battisti (2008) argues (using the diffusion of unleaded petrol in different EU Member States as an example) that fiscal incentives as well as regulation have a role in speeding up the diffusion process. His example also shows that the need for interventions differs by Member State, due to differences in 'autonomous' consumer demand.

If the VAT differentiation is successful in pushing the market penetration of a 'greener' product on the European market, this may create a competitive advantage for suppliers of this product on the world market in a later stage. Again, this so-called 'Porter' effect (see e.g. Porter and Van der Linde, 1995) is of course not restricted to this particular policy instrument.

1.4.4 Cross-border purchasing and internal market issues

In principle, VAT is levied in the Member State where the consumer resides ('destination principle'). Deviations from this principle occur when the consumer goeas abroad to buy the product. Differences in VAT rates between Member States can (if reflected in consumer price differences) lead to larger volumes of cross-border purchases than would have been the case if uniform VAT rates applied all over the EU. This size of this effect could grow if Member States were free to choose between applying reduced or standard rates to 'green' products.

The (limited) available evidence on the cross-border purchasing effect caused by different VAT rates shows that it is not negligible. In a study for the Danish Ministry of Taxation (quoted by Copenhagen Economics, 2007) cross-border shopping at the Danish-German border was estimated to be about 2 percent of total consumption in Denmark. This was driven by a difference between the German standard VAT rate of 16 percent[11] and the Danish standard VAT rate of 25 percent and probably also (although this is not mentioned by Copenhagen Economics) by the fact that Germany applies a reduced VAT rate (of 7 percent) to various goods and services, whereas Denmark is the only EU Member State that applies one single VAT rate.

[11] On 1.1.2007, the German standard rate was increased to 19 percent. According to the same study, this was expected to cut down the level of Danish cross-border shopping by 10 percent, and the level of German border trade in Denmark was expected to rise by a similar percentage. These numbers indicate rather high effectiveness of changes in the relative prices between Member States as the implied elasticity is in the magnitude of 3.

The Copenhagen Economics report states that the main characteristics of goods being particularly suited for cross-border shopping are high price per unit of weight or volume; low perishability (during transport); and limited cultural specificity. The report notes that household appliances belong to the first mentioned group of products (relatively expensive relative to weight and size) and are thus natural candidates for cross-border trade.[12]

Cnossen (2001) argues that the magnitude of cross-border shopping due to differences in VAT rates is 'minimal', and diminishes rapidly with the distance that must be covered to shop more cheaply elsewhere. Although the magnitude is not irrelevant in the border regions themselves, it is small in the national context. Cnossen also cites a study by Fitz Gerald *et al.* (1995) on the willingness of Irish consumers to travel to the UK to be able to shop more cheaply there. This study concluded that substantial VAT differences are tolerable in an internal market without harming the VAT yield of individual Member States.

E-commerce (i.e. selling goods and services through the internet) does not seem to create additional problems with respect to environmentally motivated VAT differentiation. As McLure (2003) points out, the only type of e-commerce that is problematic (in terms of VAT payment) involves sales of digital content to consumers and unregistered traders. This type of sales is unlikely to be the target of VAT differentiation for environmental reasons.

Seen from an environmental point of view, the occurrence of cross-border purchasing of 'green' goods with reduced VAT rates does not seem to be a problem, apart from the additional transport that it may lead to. However, the phenomenon does have some negative consequences for the economy and the tax revenues of the Member State where the low VAT rate does not apply.

1.4.5 'Free riders'

Any scheme providing positive financial incentives for 'green' purchasing behaviour will also benefit those who did not need that incentive because they intended to buy the 'green' product anyway. The consequence is that there will be a loss of tax revenue from these consumers without an environmental gain.

De Beer *et al.* (2000), in a study on the effectiveness of energy subsidies in the Netherlands, found that the number of 'free riders' varied between almost none and 70%, depending (among others) on the subsidised technique. IER (1998) looked at the share of 'free riders' in subsidy schemes for condensing boilers for the period 1980-1997. Using a regression model, an average 'free rider' percentage of 50% was found for the entire period. Gehring (2002) reports equally high 'free rider' rates from Demand Side Management programs in the United States. He refers to a review of dozens of rebate program evaluations that found average 'free rider' rates of 71% for refrigerator programs, 53% for air conditioner programs, and 41% for water heater programs.

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[12] As Figure 18 in the mentioned report shows, this is mainly true for electronics (with 10% cross-border trade between Germany and Denmark), but to a much smaller extent for durable household goods (with 2% cross-border trade).

This phenomenon of 'free riding' cannot be avoided[13], although one may try to minimize it by means of a careful selection of instrument parameters. In the case of VAT reduction, however, the room for manoeuvre is limited because the difference between the standard and the low VAT rate is fixed and there is limited opportunity for price discrimination. However, it does suggest that use of lower VAT rates will be more cost-effective for products where demand is price elastic.

1.4.6 Impact on government budget

A reduction in VAT rates for selected goods and services leads to lower revenues for the public budget (to the extent that these goods and services are actually substituted for their alternatives that are taxed at the standard VAT rate). Assuming that fiscal neutrality is a prerequisite, this loss of public revenue will have to be compensated somehow. An obvious way to do so would be to increase the standard VAT rate.[14]

In the case of reduced VAT rates for selected 'green' goods this increase will probably not need to be very large. For example, if we assume an initial 'standard' VAT rate of 20% and a reduced rate of 10%, and furthermore assume that the 'green' VAT differentiation applies to products representing 2% of all products and services that are subject to VAT, and that the VAT differentiation leads to a shift from the high-VAT to the low-VAT category amounting to 10% of the expenditure on those product groups, then the loss in VAT revenue would be just 0.2% of total revenues. The standard VAT rate would then have to be increased from 20% to 21% to compensate for the revenue loss. Of course governments can also decide to compensate the revenue loss by looking for other options for tax increases or expenditure cuts.

1.4.7 Opportunities for tax evasion and fraud

The existence of a reduced VAT rate makes it attractive for suppliers to have their product included in the 'low rate' category. The Copenhagen Economics (2007) study mentions various examples of the disputes that may arise around 'borderline cases'. The opportunity of VAT reduction may also be a reason for suppliers to divert scarce resources to lobbying and legal procedures with a view to obtain the low-VAT status for their product.

Although VAT in itself is a relatively fraud-proof system of tax collection, the use of different rates may also create incentives for fraud, for instance by claiming incorrectly that a certain product meets the criteria for the reduced rate. For example, an investigation in the Netherlands in 1999 revealed that in a sample of twelve washing machines carrying the 'A' energy label, eight were doing so wrongly (Minister of Economic Affairs, 2002).

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13 It is a consequence of a downward sloping demand curve where some consumers are willing to pay more for a product than others.

14 In theory, this could give rise to new distortions in the economy. However, lower VAT rates should reflect the lower externalities of the products concerned, and hence help to correct market failure. In this sense it could be argued that expanding the 'gap' between low and high VAT rates is reducing rather than increasing market distortions by pricing in external costs and benefits.

1.4.8 Wider economic impacts

Changes in tax incidence, such as a reduction of the VAT rate for specific products, will always have economic consequences in terms of economic activity, employment, income distribution etc. Albrecht (2006) argues that a 'green' VAT reform can be designed in such a way that undesirable consequences for labour supply and distribution are avoided, but adds that a detailed assessment of price elasticities is needed to determine the optimal VAT differentiation. One could add that, ideally, an analysis using a (general equilibrium) economic model would be needed to assess the economic impacts.

1.5 Administrative and compliance costs

According to Cnossen (2003), differentiated VAT rate structures complicate the taxpayer's accounting system, require additional audit oversight, increase refunds, give rise to various definitional problems, and invite misclassification. He cites a study by Hemming and Kay (1981) showing that in the UK firms with multiple-rate output have double the compliance costs of firms taxed at a single rate. Cnossen also refers to Agha and Haughton (1996), who found that by adding another VAT rate, the compliance rate is reduced by 7 percentage points.

In a report for the OECD (1998a), Cnossen also pointed out that there is evidence that the increase in compliance costs on account of differentiated rate structures is distributed regressively with respect to income: small businesses bear proportionately more of the burden than large ones. The costs of administering VAT are also increased by a differentiated rate structure, because it brings in problems of delineating products and interpreting the rules regarding which rate should be applied. Tax staff must spend extra amounts of time issuing additional assessments (if the wrong rate has been applied), settling objections, and dealing with appeals.

The Copenhagen Economics (2007) report also suggests that compliance costs are not a trivial issue and need to be seriously considered when designing lower VAT rates. An important source of these costs are the 'borderline cases' that inevitably emerge when designating product groups that will be eligible for the reduced rate. With respect to 'green' products this would underline the importance of having clear and unambiguous criteria on which the distinction can be made. Such criteria could for instance be the same as those used in the EU's ecolabelling and energy labelling schemes.

Another source of compliance costs is the existence of 'mixed products', i.e. situations where a supplier sells a 'package' of goods and/or services that are subject to different VAT rates. An example would be the case where energy efficient central heating boilers were eligible to a reduced VAT rate, whereas the service of installing the boiler would be charged at the standard rate. If the 'package' as a whole does not qualify for the low VAT rate, it may be attractive to sell or invoice the low-VAT-rated parts separately, even though this means additional costs.

1.6 VAT reduction compared to alternative instruments

As alternatives to reduced VAT rates, there are various other policy instruments providng financial incentives to consumers to buy relatively environmentally benign products. In the area of energy using products, international experiences with such instruments (e.g. rebates on energy efficient products within the framework of Demand Side Management Programmes) have been extensively documented (see e.g. IEA 2003 and 2006). Mebane and Piccinno (2006) suggest a production tax credit scheme.

In some respects, these instruments face the same problems as the instrument of VAT reduction (e.g. the need to have clear and unambiguous criteria; free rider and rebound effect). In other respects, they may avoid some of the VAT related problems (e.g. no chance of incomplete pass-through; more freedom to determine the correct size of the incentive). But they may also bring new complications with them that a VAT reduction does not have, for example if a completely new administrative scheme has to be created whereas VAT reduction can to a large extent lean on existing fiscal procedures.[15] These issues are touched upon in some of the case studies, but they are not analysed in-depth, as other studies for the Commission are addressing the relative performance of different finanical incentives to stimulate the demand for 'greener' products.

[15] For example, the administrative costs of the Dutch Energy Premium Scheme (EPR) amounted to € 41 million in 2001 and 2002: some 25% of the total amount of subsidy (€ 159 mln) (Ministry of Finance, 2003).

2. Experiences in some EU Member States with reduced VAT rates to promote 'green' products

2.1 Czech Republic

Value added tax in the Czech Republic was introduced in 1992 by the Act no. 588/1992 Coll., which came into force on 1 January 1993. It introduced a basic rate and a reduced rate, which was primary applicable on services (with exemptions stated in Annex II). Only the goods included in Annex I to the Act were to be subject to reduced rate. Among these ranked certain categories of goods where the reason for rate reduction was given by environmental considerations. The goods were the following:

- Biological products to clean waste water based on enzymes, contents for small waste water treatment plants;
- Water turbines producing up to 100 kW;
- Wind turbines producing up to 75 kW;
- Solar water heating;
- Photosensitive semi-conductor facilities incl. photovoltaic cells;
- Bio-diesel and bio-gas;
- Paper and cellulose products made with minimum 70% recycled paper.

The scheme was applied until 31 December 2003, when an amendment repealing the goods listed above entered into force. In 2004 a new Act on value added tax (Act no. 235/2004 Coll.) was adopted and became effective as of 1 May 2004 when the Czech Republic entered the European Union. The Act maintained the two different VAT rates with the exemptions listed in Annex I and Annex II. Environmentally friendly goods were not listed due to the requirements of the European Union. During the accession period, Czech Republic did not negotiate for reduced VAT rate to be applied on the goods concerned.

The responsible authority for tax collection and distribution of tax revenues is the Ministry of Finances of the Czech Republic. The fiscal function of taxes is primarily monitored and analyzed by them. Data from the tax declarations do not enable to monitor revenues by specific categories of goods or services. Therefore, data on the amount of VAT revenues from the consumption of environmentally friendly goods is not available. As a matter of fact, no changes in consumption or demand patterns can be traced. The Ministry of the Environment, Department of Economic Instruments does not follow the trends, either.

The Association of Czech Cellulose and Paper Producers was addressed with a questionnaire whether the change of VAT rate significantly influenced the demand of consumers and whether they would welcome this economic tool to be re-introduced. According to their answer, recycled paper always made up a significant part of their production inputs and this is not dependent on the VAT rate as they are not final consumers. Almost 100% of the office "recycled" paper is produced outside the Czech Republic. The increase of the VAT rate did not have a significant change on the price due to the fact that a constant increase in consumers environmental awareness multiplies the amount of "recycled" paper sold, therefore enabling the trading companies to lower its price. Still, the share of recycled office paper sold in the Czech Republic is rather low and cannot thus be a competitive commodity in terms of consumer price. Consumers of this commodity are obviously motivated by environmental considerations when buying it.

On the other hand, the use of small alternative energy-producing facilities in the Czech Republic is primarily stimulated by other economic instruments such as grant and subsidy schemes. In the respective period, clear rules for granting subsidies and grant programs were not established, which contributed to lower consumer demand.

2.2 Portugal

Portugal offers a reduction of the value added tax from a normal rate of 21 percent to a rate of 12 percent to all equipment necessary for the production and use of renewable energy resources. The country previously offered a 5% reduced VAT for renewable energy, but was revised in 2001 to the present rate of 12% due to European fiscal harmonization.

The reduced VAT rate applies to the purchasing of Photovoltaic (PV) and all other RES equipment:

- equipment for solar, wind and geothermal energy conversion;
- equipment for collecting and use of other alternative energy sources;
- equipment for energy production from incineration or transforming of waste.

Pursuant to the National Energy Strategy, the use of renewable energy sources for electricity generation in Portugal has risen. The country has reached the highest European growth rate in 2005 and the second highest in 2006. In 2005, Portugal had the sixth-largest share of renewable electricity generation in the EU-15. In terms of total generation, 36% of total generation in 2006 came from renewable sources.

Table 2.1 shows the development of the renewable energy installed capacity in Portugal since 2000. Total renewable installed capacity at the end of September 2007 was 7,365 MW, with and annual mean growth of 6.6% between 2000 and 2006. Wind power growth was 67.5%, while biogas increased 42%.

Table 2.1: Evolution of the renewable energy installed capacity in Portugal, in MW (2000-Sept. 2007)

Technology	2000	2001	2002	2003	2004	2005	2006	Sept. 2007	Mean Growth
Hydro	4,237	4,236	4,288	4,292	4,561	4,752	4,802	4,805	2.1%
Small hydro	454	480	505	509	518	518	568	571	3.5%
Large hydro	3,783	3,783	3,783	3,783	4,043	4,234	4,234	4,234	1.9%
Wind	76	114	175	253	537	1,047	1,681	2,065	67.5%
Biomass (with CHP[16])	344	344	372	352	357	357	357	357	0.6%
Biomass (with-out CHP)	8	8	8	8	12	12	24	24	20.1%
Municipal solid waste	88	88	88	88	88	88	88	88	0.0%
Biogas	1.0	1.0	1.0	1.0	7.0	8.2	8.2	11.0	42.0%
Photovoltaic	1.2	1.3	1.5	2.1	2.7	2.9	3.4	14.5	19.0%
Wave	-	-	-	-	-	-	-	-	-
Total	**4,755**	**4,819**	**4,934**	**4,996**	**5,565**	**6,267**	**6,964**	**7,365**	**6.6%**

Note: Mean growth - annual mean growth between 2000 and 2006
Source: Directorate General for Energy and Geology (DGGE)

All incentives put in place by the government to promote indigenous energy sources (tax incentives, guaranteed feed-in tariffs for renewable electricity, direct subsidy payments and the tendering/concession process) have played a part in the development of renewable energy sources. While tax incentives and subsidy payments have been used for smaller-scale renewable energy applications, feed-in tariffs and tendering schemes have been used principally for larger-scale renewable applications.

Unfortunately there are no scientific studies quantifying the effectiveness of the VAT reductions. Therefore, there is no quantitative evidence available on the extent to which the reduced VAT rate has led to increases in the demand for the eligible products and to changes in behaviour at the supply side.

However, it is commonly argued by Portuguese stakeholders that VAT reductions have not been very successful in promoting renewable energy in private households and non-

[16] Combined Heat and Power

commercial organisations. It is common knowledge within Portuguese scientific community that the contribution of VAT differentiation is rather low.[17] The main reason is that consumers can only use them if they do not have bank loans for buying a house/flat. Since most Portuguese consumers have such a loan, very few people around the country are actually qualified for getting such a reduction.

Another reason for the scarce effectiveness of the measure might be that the intermediate VAT rate of 12% applied to RES appliances since 2002 is considered by the stakeholders as an obstacle to the market development because of the 5% VAT rate applied to electricity and natural gas. The indirect tax applied to RES equipments through VAT is not competitive with gas or electricity.

Also, the 12% VAT applied to RES is not perceived as reduced enough by consumers. A 5% VAT would further reduce RES equipment price and would make it more attractive to the final consumer.

In that sense, a national environmental NGO very active in this field (Quercus), has been asking for a further reduction VAT rate for all RES equipment: from 12 to 5 percent. The Portuguese NGO argues that this reduction would have a real impact on prices and demand. Empirical evidence supports this argument, as it has been proved that major changes in VAT rates to a very large extent are passed on to consumer prices. Moreover, applying the same VAT rate to RES and natural gas/ electricity consumption would eliminate the indirect incentive to consume fossil fuels (directly or through electricity generation) rather than renewable energy sources.

The lack of scientific studies quantifying the effectiveness of the VAT reductions also makes it difficult to know the proportion in which each of the measures has influenced that change and the relative importance of the VAT reduction *vis-à-vis* other factors and incentives that affect demand. The instruments with major impact in renewable development in the country are the feed-in-tariffs for renewable electricity production, especially wind, and the effort in licensing through various tendering processes which is encouraging private investments for large wind, solar energy and biomass plants. All other instruments have had a negligible effect[18], although in the last two years small increases for individual solar thermal appliances can be attributed to income fiscal direct measures (i.e. tax credits) aimed at promoting RES in households.

In the next few years, it is expected that the newly established building codes and regulations (Regulation of energy and air conditioning systems and Regulation for thermal behaviour in buildings) will have an impact on the development of the Portuguese solar energy market. The new codes and regulations make mandatory the installation of solar panels (or equivalent renewable energy source) in new buildings.

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17 Personal communication with Departamento de Ciências e Engenharia de Ambiente (DCEA) da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa.

18 Personal communication with Departamento de Ciências e Engenharia de Ambiente (DCEA) da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa.

2.3 United Kingdom

Since 2000, in the UK a reduced VAT rate is applied to the installation of specific energy-saving materials. The uptake by paying customers (other than social housing and priority groups) has been low. One reason for this may be the fact that, since the installer buys the product for the final customer, the reduced VAT rate may not be clearly visible to the end consumer. More information on the impact of this measure is presented in the case study on insulation materials (Chapter 5 in this report).

3. Case study: Central heating boilers

3.1 Introduction

About 45% of dwellings in Europe (2004) is equipped with a central heating system that uses a heating boiler (BRG consult, 2006). More efficient heating systems, therefore may contribute to reducing the CO_2 emissions linked with the use of natural gas (and oil).

3.2 Main factors determining the impact of VAT differentiation

3.2.1 Main characteristics of the product group

Central heating boilers are used by many households to heat dwellings. The boiler is placed in the loft, shed or a separate room, and heats the house by supplying hot water to radiators (or in some cases heating pipes incorporated in the floor and/or walls). Central heating is popular, as one unit heats the whole dwelling, instead of various stoves (installed in each room).

Whereas the first central heating systems used coal, later oil was used and when natural gas became at large scale available for households (after 1960) most (new) central heating systems use gas as fuel.

Central heating is generally applied in dwellings around Europe. However, in many cases central heating makes use of external heating supply (centralized boiler houses), and in many cases an individual system is not possible due to the lack of availability of piped gas. This automatically means that the market for central heating boilers is physically limited to those households that have a central heating system (or want to install that) and have nearby supply of piped gas.

The average lifetime of heating boilers is about 15 years, although much older boilers may still be in use (the technical lifetime can be much longer).

Innovation in this market is relatively slow. Central heating as a concept already exists over a century, and boiler technology has slowly developed (from coal through oil to natural gas). Whereas older gas fired 'atmospheric' boilers have an efficiency of about 70% (meaning that 70% of the heating value of the fuel is actually supplied to the central heating system, the rest is lost through the chimney), currently 'condensing' boilers may have an efficiency of almost 100%.

For the future further developments can be anticipated, also due to the limited gas supplies and the ever increasing prices of natural gas (which are linked to the oil price). Systems that are currently seen as (very) innovative are heat pumps (either on electricity or gas), the mini CHP[19] (producing heat and electricity, achieving a higher efficiency through efficient electricity production) and fuel cells. The urgency is large to bring alternative means of heating to the market. For example, in just 50 years time, the Nether-

[19] Combined Heat and Power.

lands has achieved to already use 2/3 of its total natural gas reserves, leaving just 20 years before the Netherlands will be totally dependent on gas supplies from elsewhere (Russia, Algeria, Middle East and Nigeria).

3.2.2 Main characteristics of the market

The market for heating boilers in the EU is about 6-8 million units per year (Prodcom, 2006; BBT, 2007; BRG Consult). In monetary terms (value) the market in Europe is about € 8 billion per year (excluding the costs of installation).

It is expected that the total European market (incl. Turkey, Ukraine and Russia) for heating boilers will increase from 8.3 million in 2006 to 9.7 million by 2014 (BBT, 2007).

The market in Europe is unevenly spread: in UK and the Netherlands annual sales compared to population (in units per inhabitant) are 2.7% and 2.6% respectively. The EU average is estimated at 1.3%.

Market maturity, penetration rate, saturation

The market for (individual) heating boilers needs to be seen in a wider perspective than just the individual household boiler market. It should be seen as part of the total market for heat supply to the built up environment. Figure 3.1 gives an indication of the boiler market in different EU countries, by comparing boiler sales (2004) with population: the higher the share of population purchasing a boiler, the more important the boiler market is in that country. But one can also have an opposite view. In countries with low percentages (i.e. Finland, Sweden, Baltic countries) most households will heat their homes by other means (wood stove etc.) or are connected to for example a district heating system. Countries with a large share of homes heated by (gas fired) central heating are the UK, Netherlands, Ireland, and Italy.

3.2.3 The 'green' product alternative

Efficiency of the boiler should be distinctive. For heating boilers, the 1992 Boiler Efficiency Directive (92/42/EEC) introduced a labelling system with stars, 4 stars being the 'greenest' choice. In Member States various different labelling systems have been developed. In the UK the well known A – G labelling is applied (A being the most efficient choice, with over 90% efficiency). In Denmark a similar label is applied. In the Netherlands boiler efficiency is declared in the "gaskeur", a label developed by the "Stichting Energie Prestatie Keur" (Foundation for Energy Performance Hall-mark), which gives additional information, especially on the type of condensing boiler.

Although a condensing boiler is more efficient in the use of energy than a traditional 'atmospheric' boiler, and may be considered for VAT reduction, a heating boiler should not be seen separately from the whole heating system in homes. For example, a 'low temperature' heating system is about 10% more efficient than the regular high temperature systems, a home without insulation may require twice as much energy as a well insulated home, and integration of solar heating systems in the total heating system of a home also may add to a more sustainable way of heating.

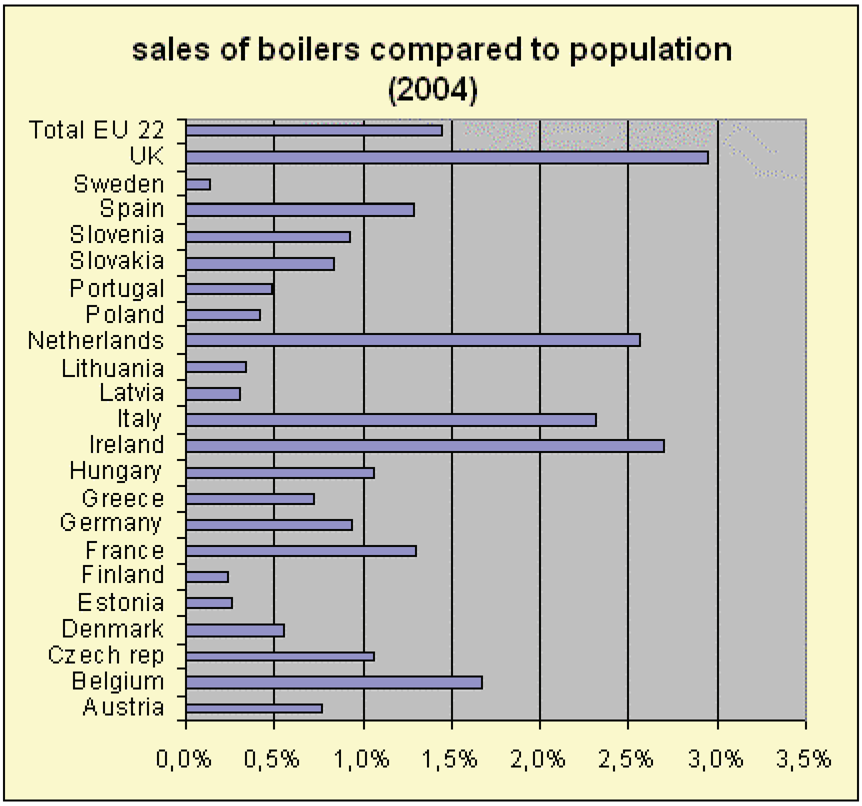


Figure 3.1: Sales of individual heating boilers in relation to population in 22 EU countries (source: BRG Consult, 2006)

The market share of condensing boilers in the EU is estimated at 43% in 2006 (see Table 3.2). There are large differences between member states: in the Netherlands the market share of condensing boilers is almost 100%, in the UK 88%, but in Italy the share of condensing boilers in total sales is just 9%.

A potential complication for increasing the market share of condensing boilers, apart from the higher price, is the installation sector. When industry was ready to supply condensing boilers to the Dutch market, in the beginning, the installation sector (which is in the Netherlands the intermediate between the boiler industry and the consumer) was not very willing to install them. They were used to installing atmospheric boilers, and their staff was (in general) not able to install condensing boilers. This frustrated the installation of condensing boilers (and thus the market penetration) for a few years. When this was recognized by both producers and the association in which the installation sector is organized (Uneto), the association started to supply training courses to their members as to teach them the necessary skills, but also to make clear that the condensing boiler market would not only lead to higher turnover (compared to atmospheric boilers) but would also lead to more installation work, and thus more turnover for the installation sector. Once installers were ready to provide the services that producers of boilers (and the consumer market) required, the penetration of the condensing boiler became successful (Frederiksen, 2006).

3.2.4 Impact of VAT reduction on product prices

Boilers are hardly bought in shops and installed by the user (no 'off the shelf' article). So additional to the costs of the boiler, also the service of installing the boiler must be taken into account (these costs are substantial). So a different treatment of the VAT for the installation service (normal rate) and the boiler (reduced rate) may be a complicating factor.

Also, installation of a condensing boiler requires more technical skills and some additional piping (compared to the atmospheric systems), so it is logical that the costs of installing a condensing boiler will be higher than the costs of installing an atmospheric boiler.

Currently, often the installation costs and the bare costs of the boiler are not separately mentioned on the invoice, which makes it difficult for a consumer to assess the possible VAT advantage. It also will be difficult to assess if the installer passes on the VAT advantage to the consumer. To ensure at least transparent VAT policies in this sector, a specification of the VAT on the invoice for consumers (possibly split in two parts, if the installation service is not granted the low rate) could be made obligatory.

Experience with other VAT reductions (in the services sector) also show that the reduced VAT rates are not always passed through to the consumers, especially if they have a temporary nature (cf. section 1.3.2).

3.2.5 Impact of price reductions on consumer demand

As no evidence is available on the effectiveness of reduced VAT rates for condensing boilers, other subsidies may serve as an example. For example, in the Netherlands, the condensing boiler has been promoted in various ways, amongst which subsidies (which lasted until 2003). It has never been researched thoroughly what the effectiveness of these subsidies has been, but some indications are given in various studies and reports. For example, ECN estimates that maximal 50% of the condensing boilers (in a limited period) would not have been bought without a subsidy (Jeeninga *et al.*, 2002). On the other hand, when subsidies on energy saving were abolished largely in 2003, the Ministry of Financed argued that the number of "free riders" was so high (84%), that the subsidy became ineffective (Ministry of Finance, 2003).

3.2.6 Impact on innovations

It is most likely that innovative behaviour of producers of heating boilers depends on future market prospects. If the VAT reduction on boilers would give a sufficient boost to demand for condensing (A-type or high efficiency) boilers, it may be expected that producers will make more effort to innovate. On the other hand, A type boilers in some member states form already the state of the art, and further innovations are linked not so much with traditional approaches (of which the condensing boiler is an example) but with for example small scale combined heat and power production, or heat pumps, which may compete with boilers, but also have other functionalities.

A possible barrier against innovations is the boiler industry is the intermediate installation sector. If this sector is not able or willing to adopt the innovations, the producers will not be able to achieve market penetration (like what happened in the Netherlands with the condensing boiler).

3.3 Assessing the impact of VAT differentiation

3.3.1 Quantitative assessment

In the quantitative assessment a few key parameters are decisive for the effects of the VAT reduction:

- price difference between green and non green alternative, before and after VAT reduction;
- market volumes of green and non green alternative;
- change in market shares due to the VAT reduction.

Price difference

The price difference between A type and B type boilers has been assessed based on two databases of characteristics of (combi) heating boilers: the UK and the Netherlands. The results of the analysis of these databases is shown in Table 3.1.

Table 3.1: Price per kW heat capacity of heating boilers, for A type (HR) boilers ('green') and B type (VR) boilers.

Type*	Netherlands Excl. VAT	UK Excl. VAT	Netherlands Incl. 19% VAT	UK Incl. 17.5% VAT	Netherlands VAT 6% for HR	UK VAT 5% for A type
HR or A type ('green')	€ 36,0	€ 38,7	€ 42,8	€ 45,5	€ 38,2	€ 40,7
VR or B type ('non green')	€ 29,7	€ 26,8	€ 35,3	€ 31,5	€ 35,3	€ 31,5
price difference (between 'green' and 'non green')	21%	45%	21%	45%	8%	29%

*: HR = high efficiency (90-99% efficiency), VR = improved efficiency (80-90%); A type: > 90% ; B type 86-90%. Prices excluding installation costs

The average capacity of a combi boiler is about 25 to 30 kW. In the Netherlands a typical HR combi boiler costs € 1,225; in the UK it would be € 1,207 (both including VAT).

However, as consumers cannot install a boiler themselves (it is not an 'off the shelf product'), additional costs are incurred by this installation service. An indication of the installation costs are given by the average price for an installed combi HR boiler in the Netherlands: between € 2,400 and € 2,940 (Menkveld *et al.*, 2004; Milieucentraal, 2008). In a newly built house, a condensing boiler would cost € 1,500. This indicates that installation costs would be between € 250 (new house) and € 1,200 (existing house) (ECN, 2004). This indicates also that VAT reduction on the price of the boiler alone (and not on the service of installing it), may be less felt by consumers. It also would require split invoices.

Market volumes

An indication of the market for boilers, by type is given in Table 3.2.

Table 3.2: Market volumes heating boilers in Europe, in units per year

Country	Condensing boiler	Atmospheric/ conventional boiler	Total boiler market	Share condensing boilers
UK	1 462 000	200 000	1 662 000	88%
NL	419 000	10 000	429 000	98%
Germany	402 000	300 000	702 000	57%
France	144 000	600 000	744 000	19%
Italy	112 000	1 100 000	1 212 000	9%
Belgium	70 000	100 000	170 000	41%
Austria	25 000	n.a.	62.000	40%
Denmark	24 000	n.a.	30 000	80%
Spain		600 000	600 000	0%
Romania		200 000	200 000	0%
Other	140 000	690 000	830 000	17%
Total EU	2 798 000	3 800 000	6 549 000	43%

Source: based on BBT, 2007 and GfK

The total market for boilers (applied in households) is estimated at 6.5 million annually in the EU. This is lower than the boiler market according to Prodcom: 8.054 million in 2006 (but this may include also other boilers).

Bosch expects that the household boiler market will grow in Europe from 8.3 million units in 2006 to 9.7 million in 2014[20] (2% per year). The market for condensing boilers will increase to 5.6 million, conventional and improved efficiency boilers will fall to 4.1 million.

Change in market shares

What change in market share can be the expected due to VAT reduction depends on various factors:

- price differences;
- gas prices and annual savings of a condensing boiler in relation with the initial investment;
- publicity campaigns;
- advise of the installation sector (and willingness to install condensing boilers);
- current trends (like the expected increase of market share of condensing boilers).

Figure 3.2 shows the market penetration of condensing boilers in some countries in various market penetration situations.

[20] This also includes Turkey, Russia, Switzerland and Ukraine

Figure 3.2 (source: BRG Consult, 2006)

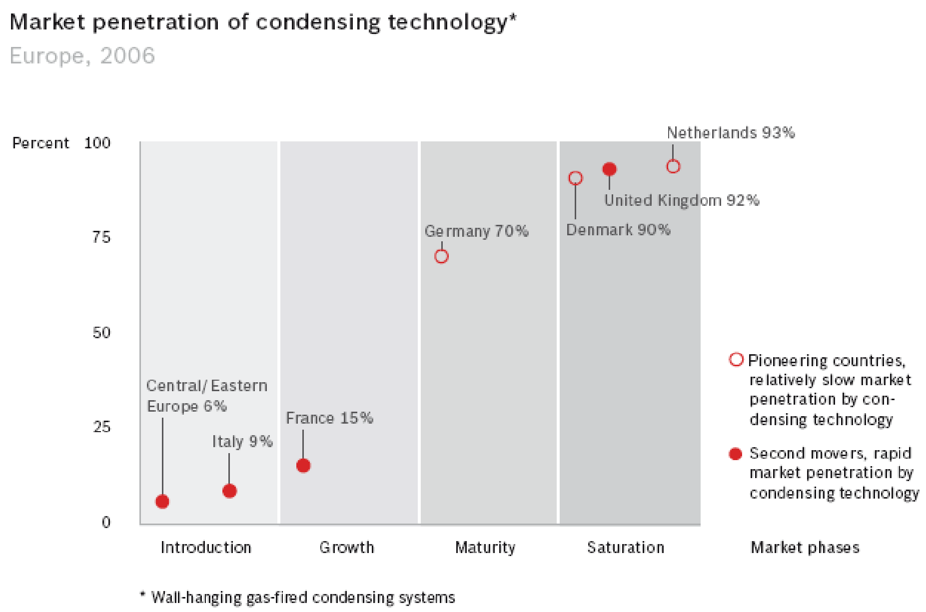


Figure 3.2 shows that for some countries the market for condensing boilers is almost saturated, whereas in other EU countries, still a large potential for increasing the market share of condensing boilers exists. Also Figure 3.3 gives an indication of potential (autonomous) shifts in the market.

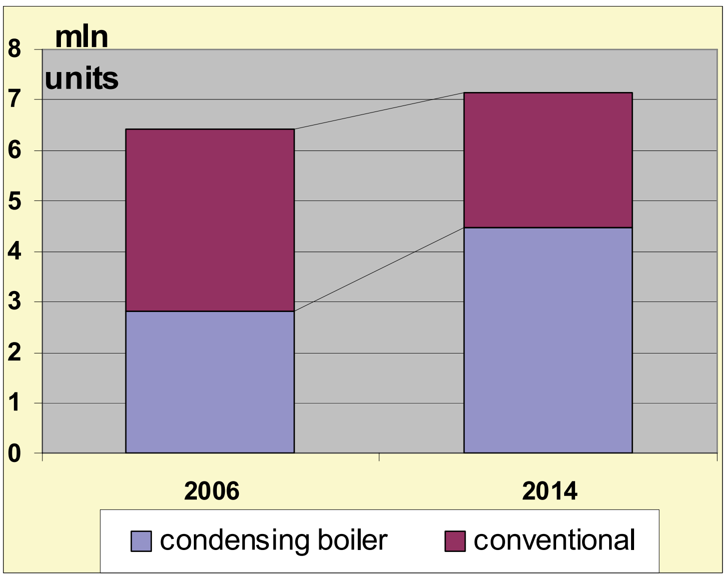


Figure 3.3: Market for condensing boilers in total (household) boiler market, 2006 – 2014 (BBT, 2007)

VAT reduction might affect the boiler market in several ways. By a lower price for condensing boilers, the product in itself already will be sold better. With a price elasticity of > 1 for durable consumption goods, each percentage price decrease would increase demand by for example 1.5%. The average advantage of the VAT reduction for the consumer is estimated at 11.5% (the average difference between standard and reduced rates across the EU), so this may induce some 17% higher volumes for condensing boilers.

But also, due to the VAT reduction, the cost difference between the condensing and other boilers becomes smaller, making the payback period for the additional investments in the condensing boiler shorter. This is shown in Table 3.3.

*Table3.3: Additional investments for consumer in condensing and atmospheric (conventional) boilers, energy savings and payback period**

Type	Investment (incl VAT)	Additional investment	Annual energy saving	Payback period (years)
B type (VR), standard VAT	€ 953			
A type (HR), standard VAT	€ 1,260	€ 307	€ 139	2.2
A type (HR), reduced VAT	€ 1,124	€ 171	€ 139	1.2

* Based on analysis of prices, labels and other characteristics of about 140 different boilers in NL (Kieskeurig.nl) and UK (Wholesale heating, 2008), average EU gas prices and an annual saving of 10.7 GJ at € 13.02 per GJ (Eurostat, 2006), excluding installation costs. Representative for gas use in "Northern" Member States. If less gas is used (e.g. in milder climate) energy savings are less, thus increasing the payback period.

Table 3.3 shows that with 2005 prices for natural gas, it is already very lucrative to invest some additional funds in a condensing boiler. It is paid back in 2.2 years (maybe in double of the time if the additional costs for installing are taken into account).

A reduction of VAT reduces the payback period to a little more than 1 year, making a condensing boiler even more attractive. High(er) energy prices are putting additional pressure on the consumers to look for ways to save on the energy bill.

Therefore, an assumption that due to VAT reduction, the market share of condensing boilers can increase much faster than is shown in Figure 3.3 is reasonable. It also can be expected that even a higher penetration of condensing boilers would be the short term (3 years) result. Taking into consideration that in the Dutch boiler market about 50% of the consumers were affected positively by the subsidy on condensing boilers (shifting their choice to condensing boilers (Jeeninga *et al.*, 2002)), it may be reasonable to assume a market share of 75% for condensing boilers as a (sort of immediate) result of the VAT reduction. Not all of the additional demand for condensing boilers will be induced by the reduced VAT rates (due to the existence of ‘free riders’), but it will be hard to separate the effects of reduced VAT from other factors.

Analysis of effects

In the above sections, the basic data needed for a preliminary quantitative analysis have been presented:

- current market and market shares;

- prices and price differences between condensing boilers and other boilers (for households);
- pay back periods of the 'green alternative';
- potential shift in market shares due to VAT reduction for the 'green alternative'.

In Table 3.4 the 2006 markets for condensing and other boilers are compared. In the base situation (2006), the market share of condensing boilers is 44%. In case VAT reduction is applied, the market volume is expected to increase to 75%.

Table 3.4: Market volumes of heating boilers (condensing and others) in units and in production. (excl. VAT)

Type	Market volume Base/2006 (unit/year)	Market Volume VAT reduction (unit/year)	Market Producers Base/2006 (€ mln)	Market Producers VAT reduction (€ mln)
Condensing boiler	2 798 000	4 800 750	€ 3,148	€ 5,401
Other boilers	3 603 000	1 600 250	€ 3,435	€ 1,526
Total	6 401 000	6 401 000	€ 6,583	€ 6,926
Market penetration	44%	75%	48%	78%

Source: BBK, 2007 and own assessment

The results also show that due to the shift in market shares, the boiler market as a whole (for producers) increases. But it is clear that producers not able to supply condensing boilers timely, could face a loss in market share, at the benefit of producers with extended experience in condensed boiler technology.

Table 3.5 shows what the effect on market values for consumer would be, and the effect on VAT revenues.

Table 3.5: Market for domestic heating boilers in the EU, base-year (2006) and hypothetical assessment of increased market share for condensing boilers, at consumer prices (incl. VAT) and VAT revenues and losses (all amounts in mln €)

Type	Market Consumers Base/2006	Market Consumers VAT reduction	VAT revenues Base/2006	VAT revenues VAT reduction	VAT loss
Condensing boiler	€ 3,733	€ 5,665	€ 585	€ 265	-€ 321
Other boilers	€ 4,074	€ 1,809	€ 639	€ 284	-€ 355
Total	**€ 7,807**	**€ 7,475**	**€ 1,224**	**€ 548**	**-€ 676**

Source: own assessment

Also for consumers the market becomes more attractive in case of VAT reduction. They would spend about 5% less (in total) than in case that no VAT reduction would be applied. This may be an incentive for consumers to increase their purchases for condensing boilers. But it is assumed that this effect is already reflected in the 75% market share of condensing boilers.

As a consequence of the reduced VAT rates, revenues from VAT levied on the sales of central heating boilers would drop drastically, by 55%.

Environmental effects

The environmental effects can be assessed in various ways. At the basis of the comparison stands the average emission of CO_2 due to the use of natural gas and the savings due to installing a condensing boiler.

The average emission of the 'non green' boiler can be estimated by assuming a certain efficiency of this boiler. In this assessment we have used an annual average use of 2000 m^3 natural gas (with a caloric value of 39 MJ/m^3), in case a conventional (or improved) atmospheric boiler is used. It is assumed that such an average boiler has an efficiency of 85%. This leads, with an emission factor of 2.15 kg/m^3 to an annual (base) emission of 4.3 tonnes of CO_2 per year/installation.

A condensing boiler would have an efficiency of 98.5% and thus emit only 3.7 tonnes of CO_2 per year, saving 590 kg of CO_2 per year on average. The following calculation shows what will be the emission reduction if VAT reduction leads to accelerated market introduction of condensing boilers (CO_2 emission reductions are calculated on basis of a lifetime of 15 years additional):

Table 3.6: Estimated environmental effect (CO_2 reduction) of reducing VAT rates for condensing boilers

	lifetime in years	specific CO_2 emissions in kg/y	number of boilers	CO_2 emissions kton	CO_2 reduction kton
CO_2 emissions, base case, conventional	15	4300	3,603,000	232,394	
CO_2 emissions, base case, condensing	15	3711	2,798,000	155,736	
Total			6,401,000	388,130	
CO_2 emissions, reduced VAT, conventional	15	4300	1,600,250	103,216	
CO_2 emissions, reduced VAT, condensing	15	3711	4,800,750	267,209	
Total				370,425	17,705

Source: own assessment based on EU market data, hypothetical market changes and standard emission factors

This analysis shows that the VAT reduction leads (maximal) 17.7 Mton of CO_2 reduction, this is 4.5% of total CO_2 emission due to individual (gas fired) heating boilers in the EU.

3.4 Conclusions/Discussion

In the analysis it has been assumed that the VAT reduction is applied in the whole EU. It this would also subsidize the purchase of a condensing boiler in the UK, Netherlands and Denmark, for which the VAT reduction hardly would be effective (as condensing boilers markets are saturated).

The market for heating boilers serves an important part of the “domestic heating” market (that also includes district heating, solar boilers, mini CHP, Heat pump)

It is expected that a reduced VAT rate for condensing boilers may induce a shift in the market towards condensing boilers from 43% (2004 market penetration of condensing boilers) to 75% in case VAT is reduced.

Such a shift would reduce CO_2 emissions (of boilers sold in one year) by about 5% (apart from CO_2 reduction due to other measures, like insulation).

Experience with the marker penetration of condensing boilers shows that a price incentive only, will probably not be enough to induce this shift. Apart from the price incentive, players on the market (especially the installation sector) have to adapt to the situation in which the condensing boiler becomes the standard. This will require acquisition of additional knowledge for this sector.

The current high market share of condensing boilers in some Member States can be partly explained by the existing regulations for the energy performance of buildings in those countries. The EPBD Directive[21], which obliges Member States to review minimum energy performance requirements for buildings regularly and to update them (if necessary) to reflect technical progress, may be a strong factor stimulating the uptake of condensing boilers in other EU countries as well.

Reducing CO_2 emission from heating will be an intermediate step in making heating of dwellings in the EU more sustainable. In the longer term, also due to the restricted availability of natural gas (and of course the expected increase in gas prices once EU becomes dependent on gas produced outside the EU), other ways of providing heat to the EU housing market will require innovative technologies like low temperature heating, optimization of the use of residual (industrial) heat, solar heating (direct for water heating, but also for seasonal storage), heat pumps, and micro CHP.

[21] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

4. Case study: Household appliances ('white goods')

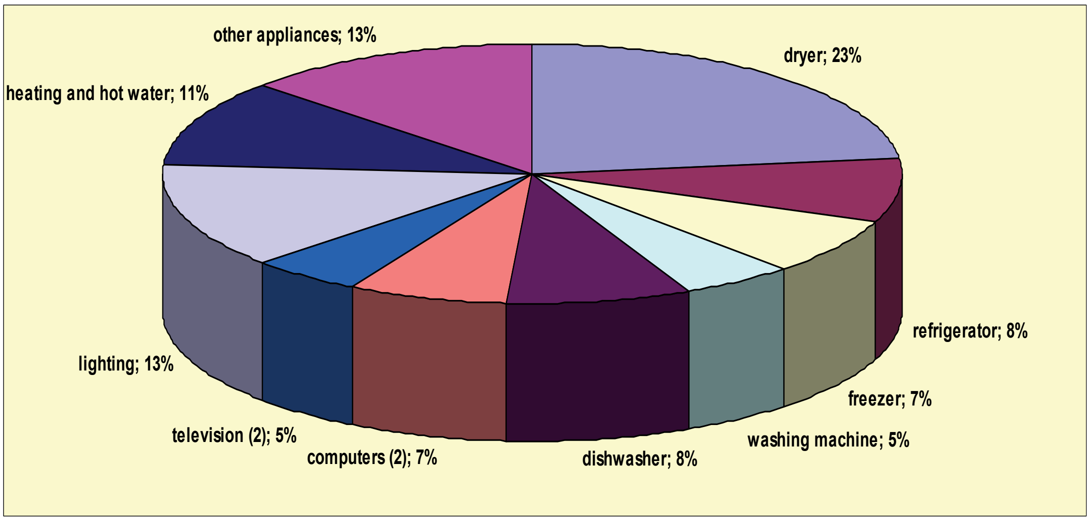
4.1 Introduction

In this case study, four types of household appliances (with a relatively large share in household electricity consumption) have been selected for further analysis:

- Refrigerators;
- Washing machines;
- Dishwashers;
- Freezers.

Figure 4.1 gives an overview of the electricity use of an average household (Milieucentraal, 2008). This shows that about 28% of the electricity use of households is linked with the four types of household appliances in this case study.

Figure 4.1: Household electricity use by type



Source: Milieucentraal, 2008

The analysis focuses mainly on the quantitative effects of VAT reduction for energy efficient appliances. In some cases, qualitative arguments are quoted from industry.

The analysis focuses on the following issues:

- Main characteristics of products in the white goods sector;
- Markets (volume, value, structure, expected shifts due to VAT reduction);
- Price, price differences and price development;
- Innovation;
- Impact of reduced VAT rates on consumer demand and producers;
- Overall impact on the market for white goods and the potential environmental benefits.

4.2 Main factors determining the impact of VAT differentiation

4.2.1 Main characteristics of the product group

This case study covers four types of household appliances: washing machines, refrigerators, freezers and dishwashers. In almost every household use is made of washing machines and refrigerators. For dishwashers and freezers, the market penetration is lower (around 50%), as not every household needs such appliances.

The mentioned household appliances serve a practical goal, and therefore, when buying such appliances, emotional arguments play a minor role in the purchase decision (for other consumer products, like cars, televisions, etc. next to practical arguments (like size, energy use, price) also emotional arguments are important (like design, colour, appearance)).

The average lifetime of household appliances is some 15 years, although in many households appliances of older age are still in use.

Environmental impact

The environmental impact of the four household appliances is mainly linked to energy use, use of water (washing machines and dishwashers) and the end-of-life of the appliances (recycling). For refrigerators and freezers, also the presence (in old models) of CFCs plays a role.

As the end-of-life for these appliances is regulated by EU legislation on this (aiming at maximal recycling and environmentally sound processing), in the case study the focus is on energy use and water use.

Table 4.1 gives an overview of the (average) annual energy and water use of the household appliances in different energy classes.

Table 4.1: Specific annual energy and water use for different household appliances, for different labels

	A++	A+	A	B	C
Fridge/freezer combination	180 kWh	252 kWh	331 kWh	451 kWh	541 kWh
Freezer 200 liter	147 kWh	205 kWh	269 kWh	367 kWh	440 kWh
Dishwasher, energy			209 kWh	249 kWh	288 kWh
Dishwasher, water			4070 l	4600 l	5500 l
Washing machine, energy		201 kWh	210 kWh	238 kWh	
Washing machine, water		9559 l	9864 l	11,000 l	

Source: Milieucentraal, 2008, own estimates (washing machines)

Considerable amounts of energy and water can be saved, if A, A+ or A++ labelled household appliances are used instead of B and C labelled appliances.

Existing VAT treatment for household appliances

Currently, household appliances are taxed at the normal, none reduced VAT rate.

4.2.2 Main characteristics of the market

Market size

Table 4.2 gives an overview of the market size of the four selected household appliances in the EU-15.

Table 4.2: Markets for household appliances in the EU-15, 2002

type of appliance	Units x 1 million	Average price € per unit	Sales € mln per year
washing machines	10.7	483	5 177
Dishwashers	4.8	574	2 750
Refrigerators	11.0	456	4 999
Freezers	3.7	334	1 234
Total	30.2		14 160

Source: GfK group, 2003

The markets for washing machines and refrigerators are mature, most purchases are for replacing older appliances (which does not mean that these are always disposed of). As market penetration for dishwashers and freezers is (much) smaller than 100%, in these segments growth is faster than in the average household appliances market.

Market structure

Several distinctions can be made for the market structure. On the production side of the market, the market is already highly centralised, with a few large producers covering over half of the total market:

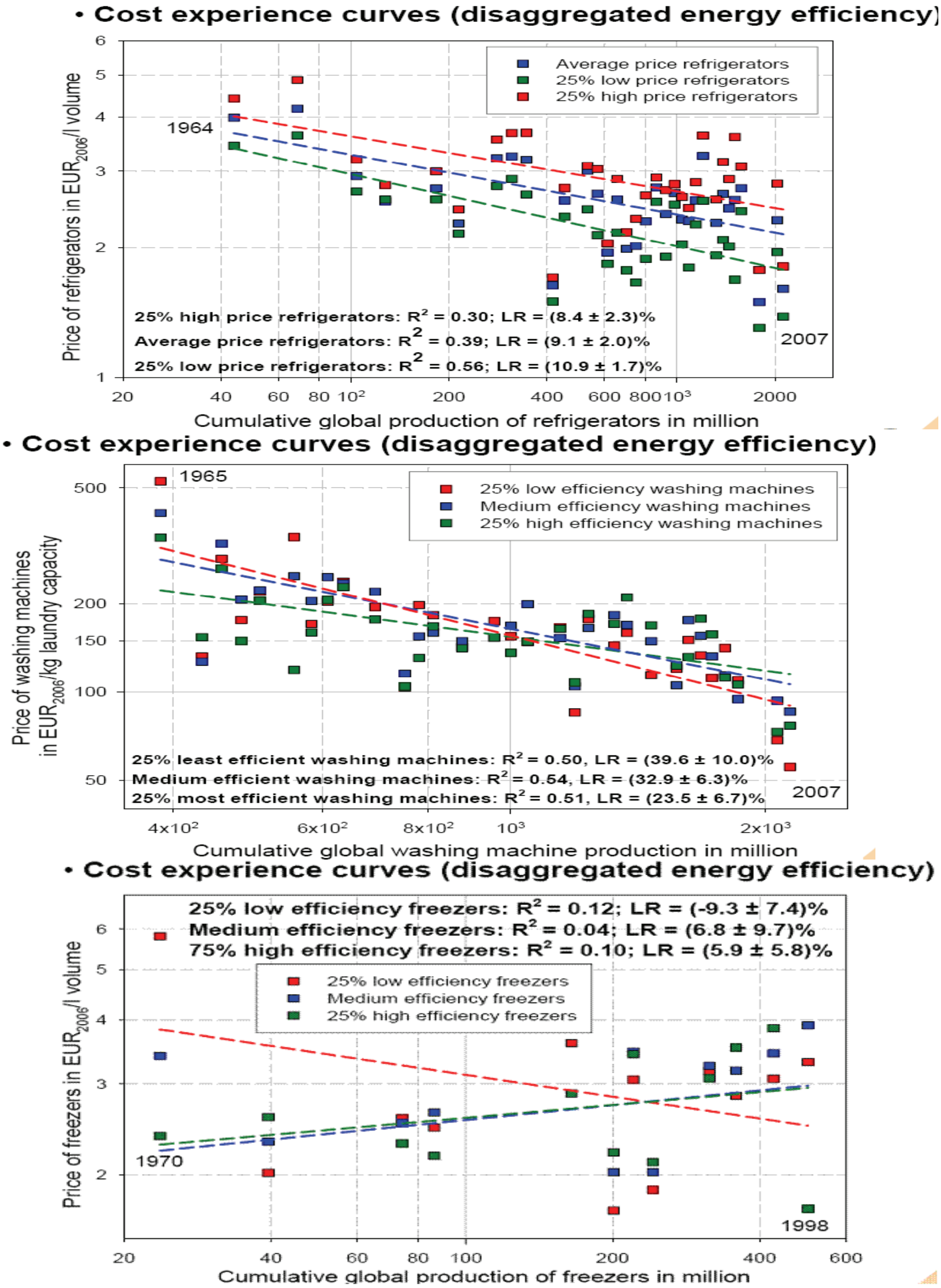
- Siemens/Bosch;
- Miele;
- Electrolux;
- Whirlpool;
- Indesit;
- Zanussi.

Most producers supply a wide range of models, and constantly modernise their supply, to satisfy the demand of the consumers (see next sections).

In the retail sector, the tendency of concentration towards a few larger retailers (like Comet (UK), BCC (NL), Mediamarkt (D, NL), etc.) also exists.

Moreover, the use of internet has made the market for household appliances more transparent, giving the consumers the opportunity to investigate supply characteristics (price, energy and water use, capacity and other product characteristics) of household appliances on line. For example, in the Netherlands the website www.kieskeurig.nl gives an overview of product prices and characteristics; in Germany for example www.preissuchmaschine.de.

Figure 4.2:Cost development of specific prices of refrigerators, washing machines and freezers in the Netherlands, by energy efficiency class and market size(source: Weiss et al., 2008)



Price development

Prices of household appliances are under constant pressure. The following reasons for the continuous drop in prices can be mentioned:

- market size;
- competition.

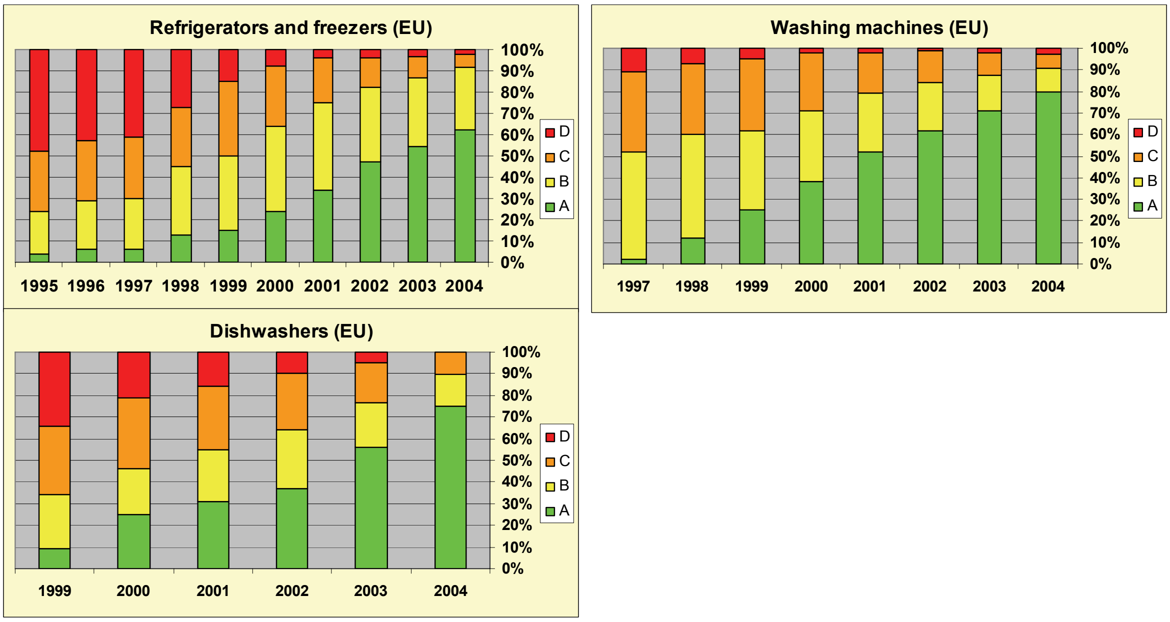
The development of prices of household appliances is given in Figure 4.2 (no data available for dishwashers).

In figure 4.2 it can be seen that in general the prices of household appliances decrease in accordance with total market growth.

Innovation

Despite or maybe as a result of the price erosion as shown above, the market for household appliances is continuously innovating, especially in the field of energy efficiency and water use. Figure 4.3 gives an overview of the development of the shares of energy labels in the EU markets for refrigerators, washing machines and dishwashers.

Figure 4.3: Technological development (energy efficiency classes) in the EU market for refrigerators/freezers, washing machines and dishwashers



Source: CECED (www.ceced.org) and GfK (2005)

Figure 4.3 shows that the market for these household appliances is constantly innovating with respect to energy efficiency. Due to this continuous improvement, the average annual energy use of the sold appliances is 1-5% lower than for the previous year.

The market penetration of A-type to over 50% of total EU sales only took between 5 years (washing machines and dishwashers) and 9 years (refrigerators and dishwashers).

These developments must be taken into consideration, when assessing the potential effect of VAT reduction on the energy efficient side of the market.

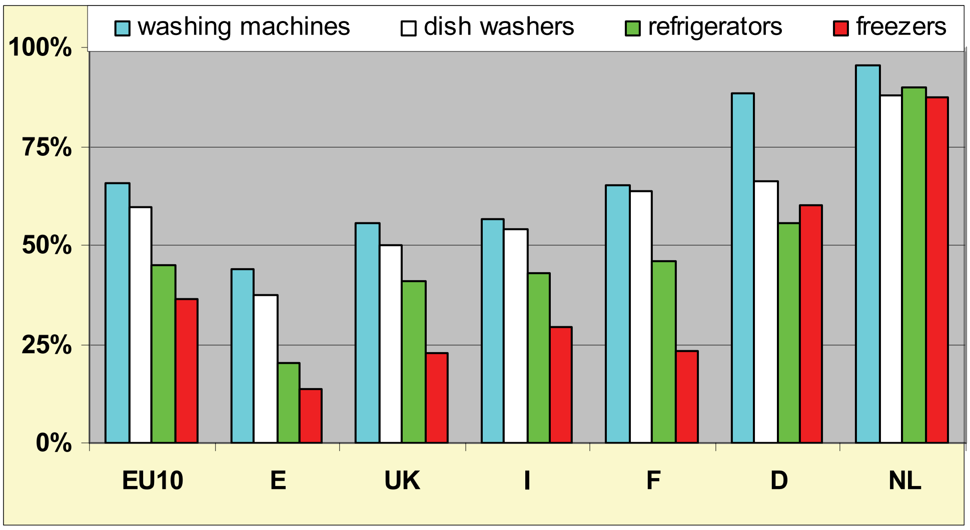
Actually, the figures show that some 10 years ago, the classification of energy labels was adequate to represent the spectrum of appliances for sale. But in 2004, in most cases the A-type is already the standard, thus indicating that there is a need for further distinction within the A class (which is already the case for refrigerators).

The continuous development of the quality of household appliances also needs to be taken into account when designing VAT reduction strategies: it would not make much sense in the current market to allow reduced VAT for everything better than B (except maybe for some markets in the new member states), as this would mostly subsidise consumers which already would by an A class appliance anyway (the problem of the "free riders").

4.2.3 The 'green' product alternative

Energy labels can be used for defining the "green alternative". A possible complication is that the market situation may vary in different member states. In some member states the take up of efficient appliances is much higher than in other markets (see Figure 4.4).

Figure 4.4 Share of A(+) type household appliances in (western) EU member states in total sales



source: GFK, 2003

This indicates that if VAT reduction is applied in the EU, there is a case for differentiations: in some member states the distinction may be between A and A+ (or better), whereas in other member states still the B-types dominate the market, making a distinction between A and B more appropriate. The disadvantage may be that undesired border effects lure.

As can be seen from table 4.1, the green alternatives are more energy efficient and also use less water (washing machines and dishwashers). Comparing the best with the worst alternative, the green alternative may be up to 3 times more efficient than the worst alternative.

In theory, more efficient appliances are more expensive to produce, which leads to higher prices for consumers for the more efficient appliances. However, not only the technology (more advanced in efficient appliances) applied is relevant, but also market size. So it even may be the case that a more efficient appliance comes at the same or even a lower price than the next best appliance.

For consumers, it is hard to figure out the price differences if linked to the energy class. As several thousand appliances are on the market, the average consumer will not be able to assess price differences between 'green' and 'non-green' appliances. Also because price differences within a category (for example large refrigerators with a separate freezing section) may be larger for different trademarks than the price difference between A and A+.[22]

In table 4.3 the prices and price differences (with the price of A) between different types of household appliances are shown, based on databases in the Netherlands, Germany and the UK.

Table 4.3: Average prices of household appliances in the Netherlands, United Kingdom and Germany, price differences (with A-class) and possible VAT advantage with low VAT rates

Appliance	E class	price NL	difference with A	VAT advantage	price UK	difference with A	VAT advantage	price DE	difference with A	VAT advantage
Washing machines	A++				€ 1.217	€ 837	€ 129	`	`	`
	A+	€ 632	€ 10	€ 69	€ 489	€ 109	€ 52	`	`	`
	A	€ 622			€ 380			`	`	`
	B	€ 489			€ 393			`	`	`
Refrigerators	A++	€ 513	€ 151	€ 56	€ 708	€ 271	€ 75	`	`	`
	A+	€ 381	€ 20	€ 42	€ 414	-/- € 23	€ 44	`	`	`
	A	€ 361			€ 437			`	`	`
	B	€ 330			€ 345			`	`	`
Freezers	A++	€ 612	€ 152	€ 67	€ 800	€ 513	€ 85	€ 557	€ 76	€ 56
	A+	€ 503	€ 43	€ 55	€ 490	€ 202	€ 52	€ 531	€ 49	€ 54
	A	€ 460			€ 288			€ 482	-	
	B	€ 419			€ 259					
Dishwashers	A+				€ -			`	`	`
	A	€ 533			€ 387			`	`	`
	B	€ 310			€ 349			`	`	`
	C	€ 359			€ 316			`	`	`

Sources: analysis of data: www.kieskeurig.nl (2008), www.preissuchmachine.de (2008) and UK Treasury, 2008

22 For example, the average specific price of a Miele freezer is € 4.32 (per litre), the average specific price of a Bosch freezer is € 3.02 (source: based on analysis of the database of "Preissuchmachine", Germany). In the same database, the specific price of an A+ freezer is € 2.62 and for the A-type € 2.38 (per litre)

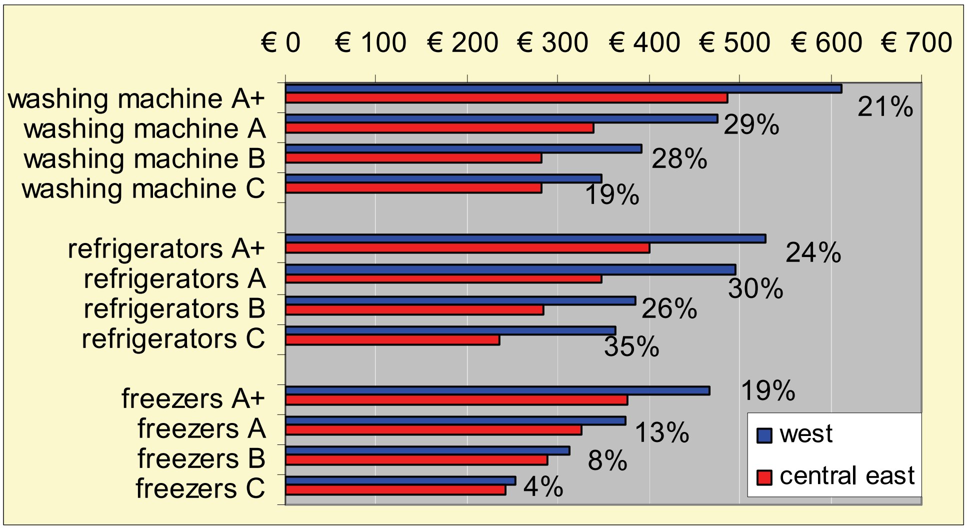
Table 4.3 shows that not in all cases the better alternatives are more expensive, in one case the more efficient appliance is even cheaper (UK, refrigerator A+).

In the table also the observed price differences can be compared with the possible advantage of the VAT reduction. This shows, that in some cases the VAT reduction can be higher than the price difference, making it for consumers extremely interesting to purchase an A+(+) type of the appliance (assuming that no emotional arguments play a role, and that the A+(+) types are in sufficient numbers available).

It can also be observed that the price differences in the UK between A-types and A+(+) types are often much larger than in the Netherlands. This indicates that different pricing strategies are applied in the UK and the Netherlands, or that the larger penetration of A+(+) appliances Netherlands leads to lower prices (due to the larger scale, thus cost savings).

It also should be mentioned that prices differ amongst member states. Information of GFK (a market research company) shows that prices of household appliances are in general higher in "old member states" than in the "new member states" (see Figure 4.5).

Figure 4.5 Price differences of household appliances between Western and Central/Eastern European countries



source: GFK, 2005

In central and eastern Europe it may well be that the appliances sold on the market are somewhat smaller than in western Europe, and less luxury, partly explaining the lower average prices.

4.2.4 Impact of VAT reduction on product prices

As the market for household appliances is very competitive (which is also clear from the constant pressure on prices as shown in figure 4.2), it is likely that a possible reduction of the VAT rates for the most efficient appliances will be passed through to the consumers for 100%. This is also confirmed by other research (Copenhagen Economics) and by the sector associations in some countries (France, UK, Netherlands). As retailers have a preference for prices like € 399 or € 149 (etc.), the new prices may be not exactly be set at the price which would result with a low VAT rate. Taking the above examples[23], € 399,- would be reduced to € 355, but might actually result in a price of € 359 or € 349, the price of € 149 would result with low VAT in € 136, but the actual price might be € 139.

As at least some of the retailers will use the VAT reduction on energy efficient appliances as a marketing opportunity and advertise with it, the VAT reduction (or advantage) will be advertised openly (and there are even arguments to make it obligatory to stores to advertise the lower VAT rate).

4.2.5 Impact of price reductions on consumer demand

As there is very little direct experience with VAT reductions for household appliances, the potential effect of a VAT reduction needs to be assessed indirectly, by analysing price differences between A(+) labelled appliances and B-labels (see above), by analysing comparable subsidy schemes applied for household appliances (see for example annex 4A) or by analysing market data (annex 4B/4C). Additionally, representatives of retailers and producers have been asked to assess the effect of VAT reduction for energy efficient household appliances.

In a theoretical approach, the price differences between household appliances of the different energy classes can be compared. As shown in table 4.3 the price difference between an A and an A+ appliance in many cases can be overcome for (over) 100% by reducing VAT to the low rate. In such cases there would be financial reason for consumers not to buy the A+ appliance, suggesting a large shift if the price difference is already small.

In the UK, in the spring of 2008 the retailer "Comet" announced a (temporary) price decrease equivalent to the removal of VAT on the most energy efficient household appliances (Comet, 2008). They report a drastic increase in sales for the product groups in question. After 2 weeks, sales of the energy efficient appliances included in the trial had almost tripled, whereas the sales of products not covered by the VAT exemption dropped 8%. This indicates an increase of nearly 10% points of the sales of A(+) labelled products, compared to the period before the (pseudo) VAT exemption trial was introduced. Although this only is a trial for a short period, it indicates that VAT reductions in practice may well be effective.

There are also other examples of tax incentives for white goods. One of the first schemes was applied in the Netherlands between January 2000 and autumn 2002, the so called EPR (Energy Premium Scheme) (see Annex 4A). The analysis in annex 4A indicates that the subsidy applied (which was about of the same order of magnitude as the reduced VAT would imply) partly has speeded up the market penetration of energy efficient appliances (in comparison with the average development of the EU market in that period). A conservative estimate indicates that the subsidy has been responsible for roughly a 15% point additional increase in market share of A(+) labelled appliances(whereas in total the shifts in market share were between 15% and 40%).

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[23] With Dutch VAT rates of 19% and 6%

Also in other member states various tax incentives have been applied. In Denmark during the last two months of 1999 a subsidy was given on A type appliances at check out. It is said that due to this action, the market share increased from 10% to 50%. In Italy, since 2006, consumers can claim an income tax credit in case they buy certain energy efficient appliances. During the first nine months of implementation in 2007, the market share of A(+) labelled appliances increased by 28%. In Spain, the "Plan Renové Electrodomésticos" subsidises energy efficient appliances replacing old appliances. It is estimated that under the subsidy, 750 000 energy efficient appliances will be sold (roughly 25% of total market for household appliances). Also in Switzerland and Hungary initiatives have been taken to increase the market shares of energy efficient appliances (see for details of the schemes: BIO (2008)).

Although the tax incentives applied for energy efficient household appliances differ from VAT reduction, the results of these incentives show that consumers will react to changes in relative prices. This is also confirmed by the results of interviews with various organisations and retailers, they all expect "a large positive effect on the market shares" of the products with reduced VAT (see annex 4C). In most cases where the effect can be assessed roughly, the subsidy induces an increase in sales of energy efficient appliances by 10% points or more (40% in Denmark).

4.2.6 Impact on producers and retailers

In general, the white goods sector has a positive attitude towards tax incentives, as it would encourage higher market shares for energy efficient appliances. The reduction of VAT rates for the "top market" would be more than enough to have a significant impact on the market share for these products. CECED, the European federation of domestic equipment manufacturers, would however prefer other tax incentives than VAT reduction (tax credits (on income tax) or direct subsides channelled through the retailers). However, this view is not common, for example British, Belgian and Dutch federations of the white goods retail sector, strongly support the idea of a reduced VAT rate for energy efficient appliances (BRC *et al*., 2008).

Producers and retailers in the white goods sector will – as a result of reduced VAT rates for certain appliances – (slightly) change their price strategies. Some of the respondents think that this is only temporarily, in the period just after the implementation of lower VAT rates. The temporary effect will manifest itself with selling out (lowering prices) for old stocks of products without VAT reduction. Another effect may be that due to the increased market shares of products with VAT reduction, production and distribution costs decrease (due to economies of scale), making it possible to lower the prices for this segment of the market. The CECED is afraid that the reduction of VAT will not be openly advertised, thus "distorting" the price image of the "top market" (as they are sold for a lower price than without the reduction). Once a product no longer applies for the VAT reduction, the resulting increase in the market-price in this segment would stimulate (perversely) sales of products with B/C labels. However, the experience with the

EPR subsidy in the Netherlands shows that after (suddenly) ending[24] such a subsidy, it is not necessarily so that the consumers demand for the A(+) appliances drops back to old levels.

In the longer term, the sector anticipates that reduced VAT rates for the most energy efficient products, will boost innovation in the sector. It thus would change (speed up) innovative effort of the sector. The introduction of reduced VAT rates also are believed to have a (slightly) positive effect on the sector profits. This indicates an expected increase in the total value of the market for white goods (due to for example the somewhat higher average prices of products sold (more A(+) products, less B and C)).

Although the market for white goods is concentrating (few very large producers and retailers) still there is more than enough choice for the consumers. Several 100´s of models are on the market, and the supply easily adapts to consumer demands. So the changes in demand of consumers will be followed by the sector. Only temporary actions ("selling out") may affect in the short term the size of the different market segments. This is also confirmed by the longer term development of the markets for white goods (see figure 4.3). As the demand for the most energy efficient appliances would increase, producers would be forced to adapt their innovation strategy. As the sector expects a structural increase of the rate of innovation, this would imply also a structural larger innovation effort for producers.

Although reduction of VAT rates as such is already believed to be effective, additional marketing efforts (linked with reduced VAT rates) are needed, and many retailers would explicitly use VAT reduction as a selling argument.

Most producers and retailers agree that VAT reductions should be dynamically implemented in the white goods sector. This implies that due to the continuously improving efficiency, the criteria for allowing VAT reduction should be tightened every once in a while. This obviously will have some side effects ("selling out" for example) around the date when stricter criteria will be introduced. CECED is afraid of these side effects, but it should be mentioned that any temporary subsidy on energy efficient products will have such effects when the scheme is stopped.

4.3 Assessing the impact of VAT differentiation

4.3.1 Quantitative assessment

In the quantitative assessment a few key parameters are decisive for the effects of the VAT reduction:

- price difference between green and non green alternative, before and after VAT reduction;
- market volumes of green and non green alternative;
- change in market shares due to the VAT reduction.

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[24] The sudden end of the EPR subsidy was induced by the large number of (assumed) "free riders", but one can also see in figure 4.5 that in 2002 the market share of A(+) was around 90%, thus giving a subsidy to almost all consumers.

Price difference

The price differences between A+(+) type and A type appliances have been assessed for the Netherlands, UK and Germany. The results of the analysis are shown in table 4.3.

Change in market shares

A way to assess the potential effects of a VAT reduction for the (most) energy efficient types (A+ or better) is to look at market shares in a base year (for EU, latest data available are for 2004). Next this is compared with the potential market shares after VAT reduction is implemented. The hypothesis is that the VAT reduction would increase market penetration of A(+) appliances by about 15% (see annex 4A). In that hypothetical case, it would be correct to replace the EU 2004 market shares by the 2004 market shares for the Netherlands. This would result roughly in the following market shares (Table 4.5).

Table 4.5: Expected shift in market shares for household appliances in the EU, when the VAT rate for A+(+) would be reduced from the standard rate to the low (or intermediate) rate

Energy class	Market shares EU 2004				Market shares after VAT reduction (compared to 2004 market shares)				Shifts in market shares induced by lower VAT rates			
	refri gerator	freezer	wash-ing ma-chine	dish washer	refri gerator	freezer	wash-ing ma-chine	dish washer	refri gerator	freezer	wash-ing ma-chine	dish washer
A++					1%	1%	1%	0%	1%	1%	1%	
A+	5%	5%			19%	19%	16%	0%	14%	14%	16%	
A	57%	57%	80%	75%	68%	68%	75%	94%	11%	11%	-5%	19%
B	30%	30%	11%	15%	10%	10%	2%	3%	-20%	-20%	-9%	-12%
C	6%	6%	7%	10%	1%	1%	4%	3%	-5%	-5%	-3%	-7%
D	2%	2%	3%	0%	1%	1%	2%	0%	-1%	-1%	-1%	0%
total	100%	100%	100%	100%	100%	100%	100%	100%				

Source: own analysis based on experience with the EPR subsidy scheme

Table 4.5 shows that it can be expected that the market shares of the most efficient household appliances would increase by some 15% points at the expense of the energy classes A, B, C and D[25]. This is more or less in line with the experiences with various subsidies for energy efficient white goods (see section 4.2.5).

Due to the VAT reduction, the cost difference between the A+ (and A++) and A types becomes smaller, making the payback period for the additional investments in these household appliances shorter. This is shown in Table 4.6.

[25] For dishwashers, no shift towards A+ is expected, due to the lack of supply of such appliances. So a reduced VAT rate for A+ appliances would not have effect in the dishwasher market.

Table 4.6: Extra costs for consumer for refrigerators/freezers/washing machines, energy savings and payback period, for A+ and A++ type, compared to A and B type

EU	refrigerator			Freezer			washing machine		
	extra costs	annual savings	payback period	extra costs	annual savings	payback period	extra costs	annual savings	payback period
A++	€ 151	-€ 25.6	5.9	€ 152	-€ 12.7	12.0			
A+	€ 20	-€ 12.9	1.6	€ 43	-€ 6.3	6.8	€ 10	-€ 3.1	3.3
A++, with low VAT	€ 95	-€ 25.6	3.7	€ 85	-€ 12.7	6.7			
A+, with low VAT	-€ 22	-€ 12.9	-1.7	-€ 12	-€ 6.3	-2.0	-€ 59	-€ 3.1	-19.3

* based on analysis of prices, labels and other characteristics of over 1000 different refrigerators, freezers and washing machines in the Netherlands, average EU electricity prices for 2006 (€ 0.136 per kWh) and a water price of € 1.5 per m^3.

Table 4.6 shows that with 2006 prices for electricity and a water price of € 1.50 per m^3 (this price differs considerably within EU, due to local circumstances), the payback period for A++ appliances (refrigerators and freezers) would decrease by 2 – 5 years if lower VAT would be applied. For A+ appliances, the additional costs with lower VAT rates would be negative in the three examples (for dishwashers no information available for A+). This leads to an immediate financial benefit to the consumers, and additional benefits of between € 3 (washing machines) to € 13 (refrigerators) per year.

Analysis of effects

In the above sections, the basic data needed for a further quantitative analysis have been presented:

- current market and market shares;
- prices and price differences between A+(+) and A appliances;
- payback periods of the "green alternative";
- potential shift in market shares due to VAT reduction for the "green alternative".

In Table 4.7 the 2004 markets for household appliances are compared with the markets as they may look like when VAT reduction for A+(+) appliances is in place. The market volumes are estimated by multiplying market shares of different energy labels with the total market volume (in units). No growth or decrease of the total market volume is assumed[26]. The market volumes in monetary terms are estimated based on the average EU prices, in combination with the price differences between energy labels as observed on the Dutch market.

[26] Although one may expect that due to price elasticity, the volume of the market would slightly increase.

Table 4.7: Market volumes of refrigerators, freezers and washing machines in units and in production value (excl. VAT), without and with VAT reduction for A+ appliances

Energy class	refrigerator		freezer		washing machine	
	units (x mln)	units VAT reduction (x mln)	units (x mln)	units VAT reduction (x mln)	units (x mln)	units VAT reduction (x mln)
A++		0,1		0,0		0,1
A+	0,5	2,1	0,2	0,7		1,7
A	6,2	7,4	2,1	2,5	8,5	8,0
B	3,3	1,1	1,1	0,4	1,2	0,2
C	0,7	0,1	0,2	0,1	0,7	0,4
D	0,2	0,1	0,1	0,0	0,3	0,2
Total	11,0	11,0	3,7	3,7	10,7	10,7
	market volume (€ mln)	market volume (€ mln)	market volume (€ mln)	market volume (€ mln)	market volume (€ mln)	market volume (€ mln)
A++		54		13		39
A+	272	1044	69	267		857
A	2937	3500	725	864	4147	3908
B	1399	460	344	113	450	84
C	287	64	71	16	287	172
D	104	47	25	12	116	86
Total	4999	5169	1234	1283	5000	5145

The results show that due to the shift in market shares, the volume in monetary terms of the refrigerator, freezer and washing machine market as a whole (for producers) increases by about 3% - 4%.

Producers not able to supply A+ and or A++ appliances, could face a loss in market share, at the benefit of producers with extended experience in high efficiency household appliances.

Table 4.8 shows what the effect on market values for consumer would be, and the effect on VAT revenues.

For consumers the market volume (in monetary terms) would hardly change with reduced VAT rates. The reduction of VAT payments is compensated by increases in the average price levels.

As a consequence of the reduced VAT rates, VAT revenues would drop, by between 13% for refrigerators and freezers to 10% for washing machines. In absolute terms the VAT reduction would lead to tax revenue loss of € 245 million in the EU.

Table 4.8: Market in the EU, base-year (2004) and assessment of increased market share for A+(+) refrigerators/freezers/washing machines, at consumer prices (incl. VAT) and estimated VAT revenues, in mln €

	refrigerator		Freezer		washing machine	
	total market incl VAT	total market incl VAT, reduced VAT	total market incl VAT	total market incl VAT, reduced VAT	total market incl VAT	total market incl VAT, reduced VAT
A++		57		13		41
A+	323	1095	82	280		899
A	3484	4151	860	1024	4919	4634
B	1659	546	408	134	534	100
C	341	76	84	19	341	204
D	123	56	30	14	137	102
total	5928	5980	1464	1484	5930	5980
	VAT revenues	VAT revenues with VAT reduction	VAT revenues	VAT revenues with VAT reduction	VAT revenues	VAT revenues with VAT reduction
A++		3		1		2
A+	51	51	13	13		42
A	546	651	135	161	771	727
B	260	86	64	21	84	16
C	53	12	13	3	53	32
D	19	9	5	2	22	16
total	930	811	230	200	930	834

Source: own assessment

Environmental effects

The environmental effects can be assessed in various ways. At the basis of the comparison stands the average emission of CO_2 due to the use of electricity (and the production of water) and the savings thereof due to purchasing A+(+) appliances.

The average emission of household appliances due to the use of electricity can be estimated by assessing annual electricity use and an emission factor (for CO_2 of electricity production). In this assessment an average emission factor for CO_2 is applied of 0.68 kg CO_2 per kWh. For water production, it is assumed that per cubic meter of water 0.3 kWh is used.

Tables 4.9a-c show the total CO_2 emissions for three types of white goods. The emissions are assessed on basis of a lifetime of 15 years, for annual sales. By comparing the estimated CO_2 emissions in the base case (without VAT reduction and old market shares) with the reduced VAT case (with VAT reduction and new market shares), the total effect on CO_2 emission can be assessed.

Table 4.9a: Estimated environmental effect (CO_2 reduction) of reducing VAT rates for A+ and A++ refrigerators

Energy class	specific energy use (kWh/year)	specific CO_2-emission (kg/year)	Total CO_2 emission base year (mln kg)	Total CO_2 emission VAT reduction (mln kg)
A++	114	77		95
A+	192	130	1073	4117
A	271	184	17262	20571
B	279	190	9270	3049
C	279	190	1904	422
D	279	190	687	312
			30195	28566

Table 4.9b: Estimated environmental effect (CO_2 reduction) of reducing VAT rates for A+ and A++ freezers

Energy class	specific energy use (kWh/year)	specific CO_2-emission (kg/year)	Total CO_2 emission base year (mln kg)	Total CO_2 emission VAT reduction (mln kg)
A++	202	137		56
A+	255	173	481	1844
A	287	195	6172	7355
B	388	264	4348	1430
C	388	264	893	198
D	388	264	322	146
			12216	11031

Table 4.9c: Estimated environmental effect (CO_2 reduction) of reducing VAT rates for A+ and A++ washing machines

Energy class	specific energy use (kWh/year)	specific CO_2-emission kg/year	Specific water use (liter/year)	Specific CO_2 emission (water) kg/year	Total CO_2 emission base year (mln kg)	Total CO_2 emission VAT reduction (mln kg)
A++	190	130	9000	1,8		157
A+	201	136	9500	1,9		3599
A	210	143	10000	2,0	18539	17468
B	238	162	11000	2,2	2902	542
C	238	162	11000	2,2	1768	1055
D	238	162	11000	2,2	712	528
					23921	23349

Source: own assessment based on EU market data, estimated market changes and standard emission factors

This analysis shows that the VAT reduction leads to a CO_2 reduction of in total 3.4 Mton per year for the appliances assessed. The relative reduction would be in the order of 5%.

The above analysis presents average results for the EU market as a whole. As already indicated, the market structure (in terms of market shares of the various energy labels) differs amongst member states. So in member states with a relative low penetration of energy efficient appliances (South, Central-East) it may be anticipated that the effects will be larger than in the “mature” markets (West, North). Increased innovation, as is expected by the white goods sector, may also lead to higher replacement rates (as in theory, the payback times of new energy efficient appliances are shortened, making it financially more attractive for consumers to replace older appliances). This may especially be the case in the less mature white good markets (South and Central-East Europe).

As too little information is available on the potential differences in effects of VAT reductions in specific member states (in relation to the market structure), it is not possible to assess in quantitative terms the effectiveness of VAT reductions for individual member states. But in general, larger effects may be anticipated in the less developed markets.

Conclusions/Discussion

In the analysis it has been assumed that the VAT reduction is applied in the whole EU for A+(+) household appliances.

The analysis shows that the exact effect of a VAT reduction is difficult to assess, but there is a common opinion in the white goods sector, that reduced VAT rate indeed will speed up the take up of the more energy efficient appliances significantly.

Within the sector, not all representatives would support the reduced VAT rate instrument. CECED advocates other types of subsidies (like the subsidies given in Spain and Italy), to avoid market distortion. However, in other Member States (UK, B, NL) white goods retailer associations strongly support the initiative of Sarkozy and Brown.

As the market for household appliances is very dynamic, a shift in market shares of energy labels will occur to a certain extent autonomously. By means of analysing the effects of the Dutch EPR subsidy in comparison with EU market trends, the hypothesis is made that a (positive) shift of 15% in market shares or a 2 – 4 years speeding up of innovations can be achieved when applying financial incentives, like reduced VAT rates.

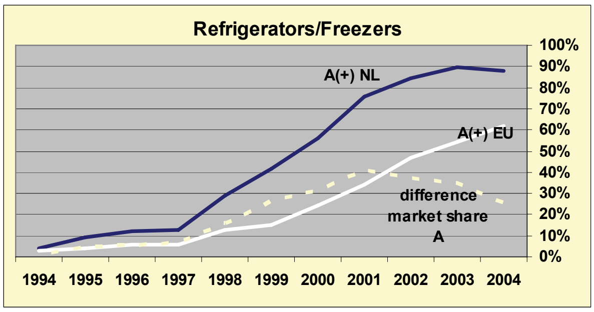
Also, the industry expects that a reduced VAT rate for A+(+) appliances will speed up market introduction of these appliances. It also will affect (temporarily) pricing strategies of the industry (to “sell out”), but as a whole, the effect on the industry is assessed positively (increased innovation, increased turn over and profits).

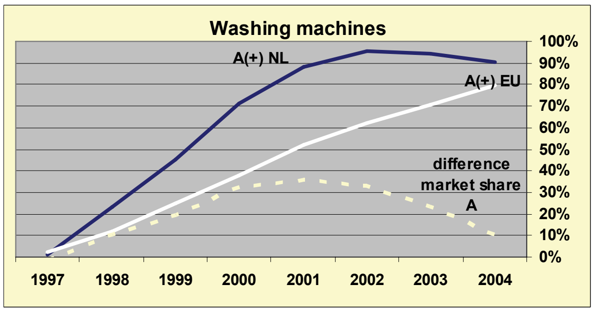
Annex 4.A

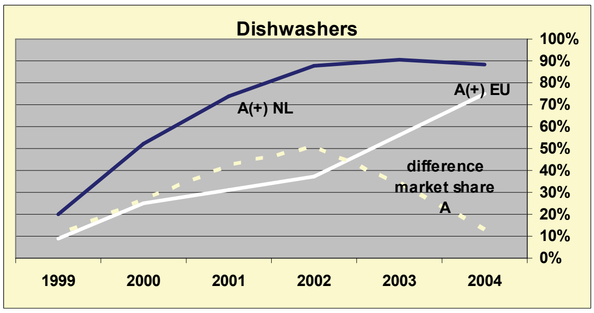
In this annex, the EPR subsidy scheme – as applied in the Netherlands between begin 2000 and autumn 2002 – will be analysed in the context of the differences in the market development in the Netherlands compared to the EU.

As the market for household appliances is constantly developing in a more efficient direction, the impact of subsidising part of the market cannot be simply estimated by making use of price elasticities. In such a dynamic market, the effect of subsidising would rather be an acceleration of innovation (by maybe a few years) than change the market structure permanently. This can be partly illustrated by Figure 4A1, in which the market share of A(+) type appliances in the EU is compared to the Netherlands.

Figure 4A.1: Development of market share of A(+) appliances in the Netherlands, compared to the EU, refrigerators/freezers, washing machines and dishwashers, 1994/1997/1999 - 2004







(source: own analysis based on CECED (internet); GfK (2005), Milieucentraal (internet); Vlehan (2005; 2008))

Figure 4A.1 shows that starting from (almost) the same market penetration at the launch of A types on the market, the increase of the market share in total sales is (much) faster in the Netherlands than in the EU-average. The difference between NL and EU market shares is largest in 2001/2002: refrigerators/freezers: 40%, washing machines: 35%, dishwashers 50%.

But one can also see that after a few years, the difference between EU and NL gets smaller again and in the end (2004) almost disappears. So the working hypothesis is that in the Dutch market for one or another reason, the market penetration of A types has been speeded up compared to the EU.

There may be several reasons to explain the faster growth of the market shares for A(+) types in the Netherlands:

- The Netherlands is one of the richer member states, which may partly explain why consumers choose more expensive but also more efficient appliances. Actually, a study found that functionality/performance of a large household appliance is the most important factor in the purchase decision (56% of respondents; price was most decisive factor for 17% (see Molenaar, 2006));
- Consumers may be aware of the economic advantage of A(+) types and sometimes will compare future energy savings with additional costs of the more efficient type;
- Environmental awareness campaigns, for example, the government and shops have always promoted the energy labels as something to be taken into consideration;
- From the beginning of 2000 till the autumn of 2002, a subsidy was given on various CO_2-saving appliances (€ 50 for an A-class refrigerator/freezer; € 100 for an A+-class refrigerator/freezer; €100 for an AAA washing machine and € 50 for an A dishwasher). Compared to the average prices of household appliances in 2000, the subsidy ranged from 10 – 20% of the sales price.

Although it is tempting to explain the differences between EU and the NL as a consequence of the subsidy (which was in effect quite comparable to what a reduced VAT rate would achieve), the graphs in Figure 4.5 show that already before the introduction of the EPR subsidy on household appliances a difference in market share existed in 1999. The difference in market share for A(+) types between NL and the EU was:

- for refrigerators/freezers: 27% (maximal difference 42% in 2001);
- for washing machines: 20% (maximal difference 36% in 2001);
- for dishwashers 11% (maximal difference 51% in 2002).

By comparing the differences before introduction and during the period the EPR subsidy existed, one can conclude that the EPR subsidy may have had a maximal effect of 15% additional market share (to the EU average) for washing machines, refrigerators and freezers, and up to 40% for dishwashers.

If the above reasoning is correct, a reduction of VAT rates for the energy efficient appliances would raise demand by 15% points (% of total market) (assuming that the 40% for dishwashers would be also caused by other factors[27]). This would mean that about half of the difference actually can be linked to the subsidy, and the other half to other factors.

Another way to look at the above analysis is not to focus on the differences between market penetration between NL and EU in a given year, but to assume that the A(+) types will anyway penetrate the market in the somewhat longer term, and that the difference should be viewed in years ahead of the average EU market. This hypothesis is at least partly confirmed by the graphs. One might estimate that the Dutch market has been 3 to 4 years ahead of the EU market in buying A(+) appliances. So, assuming no financial incentives being used in the EU in the period of analysis (but maybe also the lack of other instruments to seduce consumers to buy A(+) appliances), maximally a 4 year advantage can be achieved by a financial incentive like the reduced VAT for the most efficient appliances.

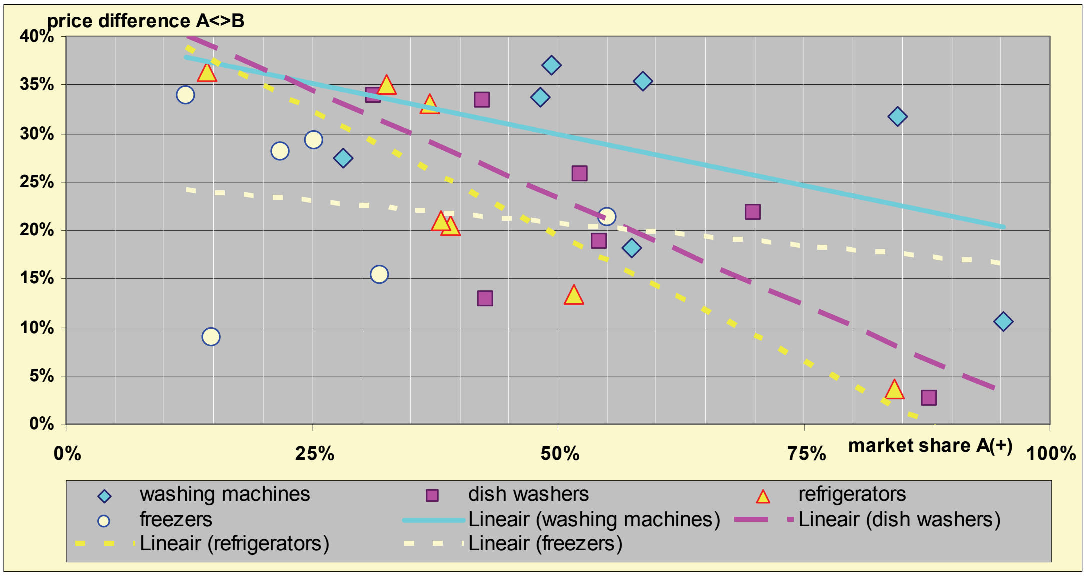
Annex 4.B

In this annex the relationship between on the one hand the market shares of A(+) types of household appliances and on the other hand the price differences between A(+) and B-labelled appliances is investigated. Figure 4B.1 gives some results for washing machines, refrigerators, dishwashers and freezers.

Although the correlation is not strong, one can see by the slope of the trend lines, that in general a smaller price difference leads to a higher market share for A(+) type appliances. So lower prices for A(+) labelled household appliances would lead to a higher demand and market share for these appliances. The trend-lines suggest that a 10% decrease in price difference could lead to an increase in market share of between 18% (refrigerators) to 45% (washing machines) or even 80% (freezers).

[27] In some of the interviews, the Dutch market for household appliances is mentioned to be a "sort of test market" (as producers are continentally oriented, this may be the case).

Figure 4B.1: Market share of A(+)appliance in west EU member states in relation to the price difference between A(+) and B labelled household appliances



Source: analysis based on GFK, 2003

As the data used in this analysis are dated (2003), and the markets have in the meantime developed further (in the direction of A(+)-labelled appliances), the values from the above analysis should only be seen as indicative.

It also can be argued that the price difference is not the driving force for the market share, but that a high market share enables retailers (and producers) to supply the market at lower prices (due to economies of scale).

Annex 4.C

In this annex the questionnaire responses obtained in the interviews with representatives from the industry are presented. 5 organisations answered to the questions, 3 Dutch organisations and 2 French organisations.

When reviewing the answers it appears that in most cases there is a large similarity in the answers on the issues raised. 'Outliers' are indicated in red.

Legenda: 1 = don´t agree at all; 5 = fully agree

Statement	NI1	NI2	NI3	F1	F2
1) A reduction of the VAT rate on environmentally advanced products will have a large positive effect on the market share of that type of product.	5	5	5	5	5
2) The financial advantage of a reduced VAT rate (to the consumer) is too little to have a significant effect on market shares	2	2	2	3	1
3) The financial advantage of a reduced VAT rate will be <u>the most important driver</u> of speeding up the market introduction of environmentally advanced products	4	4	4	**2**	5
4) The reduced VAT rate will be passed through for 100% to consumers	4	4	4	3	5
5) Retailers and producers will try to increase profits by only passing through a part of the VAT reduction to consumers	3	2	2	3	1
6) A reduced VAT on environmentally advanced products will not change the price strategies of producers	2	3	2	1	3
7) A reduced VAT on environmentally advanced products will not change the price strategies of retailers	2	**5**		2	1
8) For environmentally advanced products the profit margins (for producers and retailers) are normally lower than the average profit margins on the whole spectrum of products	2	3	2	2	**5**
9) Reduced VAT or other financial incentives for environmentally advanced products will speed up market introduction of such products	4	4	5	**2**	5
10) A larger demand for environmentally advanced products will have a positive effect on innovation rates in the sector	5	5	3	5	5
11) A larger demand for environmentally advanced products will have a positive effect on profits of the sector	4	4	3	4	5
12) A larger demand for environmentally advanced products will <u>only</u> benefit the most innovative producers in the sector	**2**	4	4	3	4
13) A reduced VAT on environmentally advanced products will have an impact on the price of other products (i.e. non-environmentally advanced)	4	4	4	4	4
14) A reduced VAT on environmentally advanced products will 'indirectly' increase consumers' awareness on energy efficiency and environmental issues	4	4	5	**2**	5
15) Apart from the financial incentive it provides, a reduced VAT rate will act as a 'signal' that buying that product is 'the right thing to do' or that 'you are getting more than you pay for'	4	4	4	**2**	5
16) Non-financial considerations (consumer habits, trends, fashion; perception, trust, beliefs and prejudices; media influence; advertising and promotion; regulations and legislation etc.) are much more important determinants of consumer choice than financial ones	2	2	2	**4**	2
17) Most consumers are myopic. They will buy the least expensive product, even if it is clear that the higher price of the more expensive alternative is earned back in a few years through lower energy bills	2	3	2	**4**	**4**

Statement	Nl1	Nl2	Nl3	F1	F2
18) Reduced VAT rates for environmentally advanced products will only be effective if they are accompanied by promotional campaigns for those products	4	**2**	4	4	5
19) Introducing a dual VAT rate will increase the one off and on-going costs of VAT administration for retailers substantially (by more than 10% of their present VAT administration costs).	3	3	3	3	2
20) The criteria for VAT reduction need to be differentiated by Member State. In some countries, the market share of environmentally advanced products (e.g. with the ‘A‘ energy label) is already large, and those countries should apply stricter criteria than the others	**2**	**2**	4	3	4
21) The criteria for VAT differentiation should be applied in a dynamic way. They should become stricter every 3-6 years, so as to ensure that only the most environmentally advanced products available on the market qualify.	4	4	5	3	4
22) The market for the product group we are talking about is a very dynamic one, and there is an autonomous trend towards environmental improvement. Introducing a reduced VAT rate will do little to speed up that trend.	2	1		3	1

5. Case study: Thermal insulation

5.1 Introduction

Thermal insulation combined with the application of energy saving windows holds a key position to lower the CO_2-emissions of the European building stock. Adding thermal insulation to existing buildings in the EU could potentially reduce the CO_2-emissions and the respective energy costs for heating by 42% (Eurima, 2002). This corresponds to an annual avoidance of 353 million tons of additional CO_2 emissions. The lion's share of this reduction potential is located in the moderate climatic zone[28].

5.1.1 Main characteristics of the product group

The product group under consideration includes cavity wall insulation, loft insulation and draught stripping insulation for walls, floors, ceilings, roofs, lofts, water tanks, pipes and other plumbing fittings, double glazing and draught stripping for windows and doors.

Insulation types

Insulated dry lining – often used insulation for both new build and refurbishment is to dry-line the walls with a composite insulation/plasterboard. With the correct materials, this technique not only delivers excellent insulation performance, but also provides vapour control and a first-class plastering or decorating surface in one board.

External insulation – these systems are made up of an insulation layer fixed to the existing wall (using a combination of mechanical fixings and adhesive, depending on the insulation material used) and a protective render or cladding finish.

Loft insulation – insulation of the loft with mineral wool quilt, blown mineral wool or blown cellulose fibre which prevents heat loss in winter (and also heat gain in summer).

Cavity wall insulation - Cavity wall insulation is injected with either mineral wool, foam or beads into the cavity between the inner and outer leaves of brickwork that make up the external wall of a property.

Most of the above insulation products have an average lifetime of 30 to 40 years.

5.1.2 Environmental impact of insulation materials

Buildings are the largest single energy-using sector accounting for 40% of Europe's energy (Figure 5.1). This amounts to 842 million tonnes of CO_2 emissions in the EU, which is around twice Europe's Kyoto target. Energy saving insulation materials can reduce emissions from buildings (new and existing) by 460 million tonnes of CO_2 per year.

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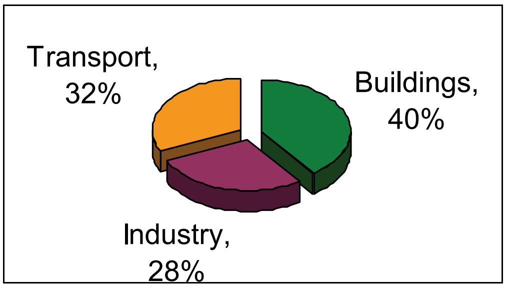
[28] Europe's moderate central climatic zone includes Belgium, Denmark, Germany, France, Great Britain, Ireland, Luxembourg, the Netherlands, Austria and Switzerland.

For example, a properly insulated home uses only 27% of the energy that is needed to heat a standard house built before 1974 (Eurima, 2006a).

Figure 5.1 Energy use in Europe



Source: Eurima (2006a)

5.2 Existing VAT treatment on energy saving materials in the EU

Reduced VAT rates are in place for energy-saving building materials and heating equipment in the United Kingdom, and a reduced VAT rate applies to renovation work in the housing sector in France (as well as in some other Member States). The installation must be done by a professional or approved contractor.

Labour accounts for a high proportion of the cost of installing energy saving materials, and the actual product cost is not more than 10% of the overall cost. Thus the installation service which accounts for the largest part of the overall cost also attracts a VAT discount in the UK and France. The discount on installation services by professional installers only was imposed to avoid black market operations and cross border purchases.

A closer look at the VAT rates across member states (Table 5.1) points to a set of perverse incentives attributed to the differential VAT rates on energy and insulation materials. In ten of the 27 member states the VAT on domestic energy is lower than the VAT rate on energy saving materials (eg. thermal insulation products). The current VAT regime encourages end-users in these member states to use energy inefficiently by applying a reduced VAT rate on energy supplies, while at the same time discouraging them to apply solutions, such as insulation, which would rationalise the use of energy and which are usually covered by a significantly higher VAT rate.

In theory, this would lead to higher energy consumption and lower demand for energy saving materials, both resulting in higher CO_2 emissions. VAT rates on domestic energy are low in certain member states mainly on social grounds, such as reducing fuel poverty.

Table 5.1 VAT rates on energy and on insulation materials in the EU

			VAT rate on Natural gas		VAT rate on Electricity		VAT rate on insulation materials
1	Belgium	BE	21		21		21
2	Bulgaria	BG	20		20		20
3	Czech Republic	CZ	19		19		19
4	Denmark	DK	25		25		25
5	Germany	DE	19		19		19
6	Estonia	EE	18		18		18
7	Greece	EL	9		9		19
8	Spain	ES	16		16		16
9	France	FR	19.6	5.5	19.6	5.5	19.6
10	Ireland	IE	13.5		13.5		21
11	Italy	IT	10		10		20
12	Cyprus	CY	5		15		15
13	Latvia	LV	5[a]	18	18	5[d]	18
14	Lithuania	LT	18		18		18
15	Luxembourg	LU	6		6		15
16	Hungary	HU	5		20		20
17	Malta	MT	-[b]	18[c]	5		18
18	Netherlands	NL	19		19		19
19	Austria	AT	20		20		20
20	Poland	PL	22		22		22
21	Portugal	PT	5		5		21
22	Romania	RO	19		19		19
23	Slovenia	SL	20		20		20
24	Slovakia	SK	19		19		19
25	Finland	FI	22		22		22
26	Sweden	SE	25		25		25
27	United Kingdom	UK	5		5		17.5

[a] To natural persons for private consumption
[b] When supplied by public authority – outside the scope of VAT
[c] When supplied in cylinders – 18%
[d] To natural persons for private consumption

Source: European Commission (2008a).

Box 5.1 Existing VAT Treatment on energy saving materials in the UK

Budget 2000 reduced the rate of VAT from 17.5 per cent to 5 per cent on the installation of specific energy-saving materials (insulation, draught stripping, hot water and central heating system controls and solar panels) provided that they are professionally installed in a residential or charitable property. It also introduced a 5 per cent reduced rate of VAT for the grant-funded installation of new central heating systems and their maintenance and repair, and heating appliances (for example, electric storage heaters and gas fired boilers) in the homes of the less well off. For programmes such as the Home Energy Efficiency Scheme (HEES) in England, which provides central heating systems for low-income, older and other vulnerable householders at risk of ill-health from cold homes it is estimated to have benefited some 20,000 households.

The reduced rate covers:

- all insulation, draught stripping, hot water and central heating controls;
- installations of solar panels, wind and water turbines;
- ground-source and air-source heat pumps and micro-CHP; and
- wood-fuelled boilers.

The reduced rate does not apply to purchases for DIY installation.

VAT is charged to the thermal insulation installer at the standard rate of 17.5%. This is considered to be a business expense (ref section 10 of the VAT guide) and as such can be reclaimed in full from HM Customs and Excise (HMCE). Once, the installer buys the specific energy saving materials they can reclaim the 17.5% VAT from HMCE. The VAT charged on the installation of materials is at 5%. This is considered to be a taxable supply (ref section 7 of the VAT guide). So, the installer charges 5% to the customer, and then goes on to pay this 5% to HMCE.

5.3 Main characteristics of the market in Europe

5.3.1 Market size and growth

In 2007, the thermal insulation market in product terms in Europe (EU-27) was worth €30 billion.[29] Across Europe, favourable building regulations and rising energy prices are set to drive significant uptake of both renewable as well as inorganic thermal insulation materials. This, together with recovering economies in several European states, will reinforce demand for efficient thermal insulation materials.

Glass wool is the largest product segment due to its excellent fire resistance coupled with acoustic insulation properties and low cost, which makes it the preferred market product. At the same time, demand for stone wool offers strong growth potential, particularly in high-performance applications in industrial insulation. Renewable resource thermal insulation materials are also likely to witness increased uptake due to their environment-friendly properties. Bolstered by these trends, revenues in the inorganic and renewable resource thermal insulation materials markets in Europe are expected to grow from € 2.5 billion in 2005 to € 2.9 billion by 2012.[30]

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29 Personal communication from Eurima.

30 http://www.prnewswire.co.uk/cgi/news/release?id=163432.

Eurima, the European insulation industry sector association were unable to provide more details on the size and the growth of the market in Europe as EU Competition laws forbid them to keep such figures from 2002. However, Eurima were able to say that the market has been very buoyant in the last few years. Demand has been increasing due to higher energy prices and stricter building regulations.

In the UK, the internal wall insulation sector has increased sales by 55% between 2001 and 2005 and represents approximately 6% of the UK thermal insulation market. The number of properties fitted with internal wall insulation is difficult to quantify, but evidence from interviewees and literature suggests that the flexible internal market delivers around 2 million m^2 pa and the insulated rigid board market around 4 million m^2 pa. According to the NIA, the manufacturing base in the UK has been increasing in the last 5 years. Nearly 80% of the UK demand is met by the domestic market.

The determinants of the market size for energy-efficient products and energy-saving materials are not identical. In the case of energy-saving materials, demand is based on whether consumers wish to invest in the material, with anticipated energy savings being the principal rationale for the purchase. In the case of energy-efficient goods (such as household appliances; see Chapter 4), market size is determined by both the demand for the appliance category (irrespective of its energy efficiency) and the substitutability of demand between more and less efficient models of that appliance.

5.3.2 Market maturity, penetration rate, saturation

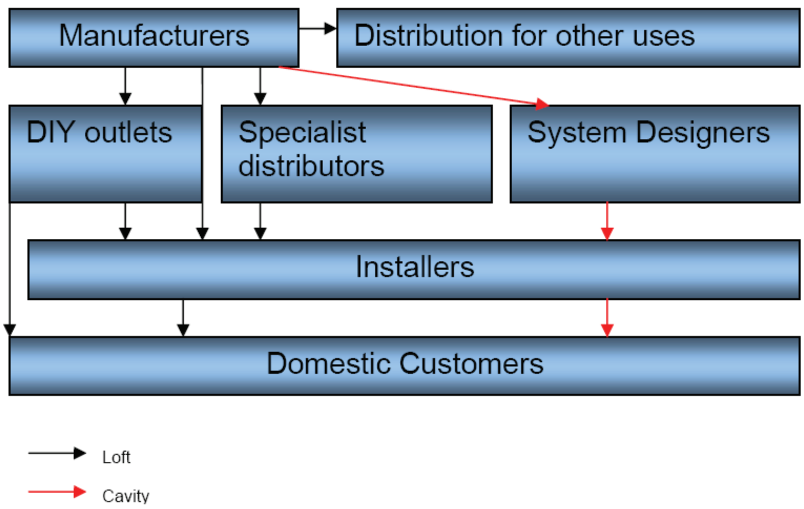
The insulation market in Europe is very concentrated, with only a handful of manufacturers meeting the demand of 27 member states (Figure 5.2).

Figure 5.2 Main insulation materials manufacturers in Europe

The supply chain for insulation products is not very complex. The installers are the key link in the chain for reaching final consumers.

The supply chain for loft insulation is slightly different to that for cavity wall insulation (see Figure 5.3). Loft insulation is sent to specialist distributors, builders' merchants or DIY stores where it is bought by professional installers or households.

Figure 5.3: Supply chains for domestic retrofit cavity wall and loft insulation.



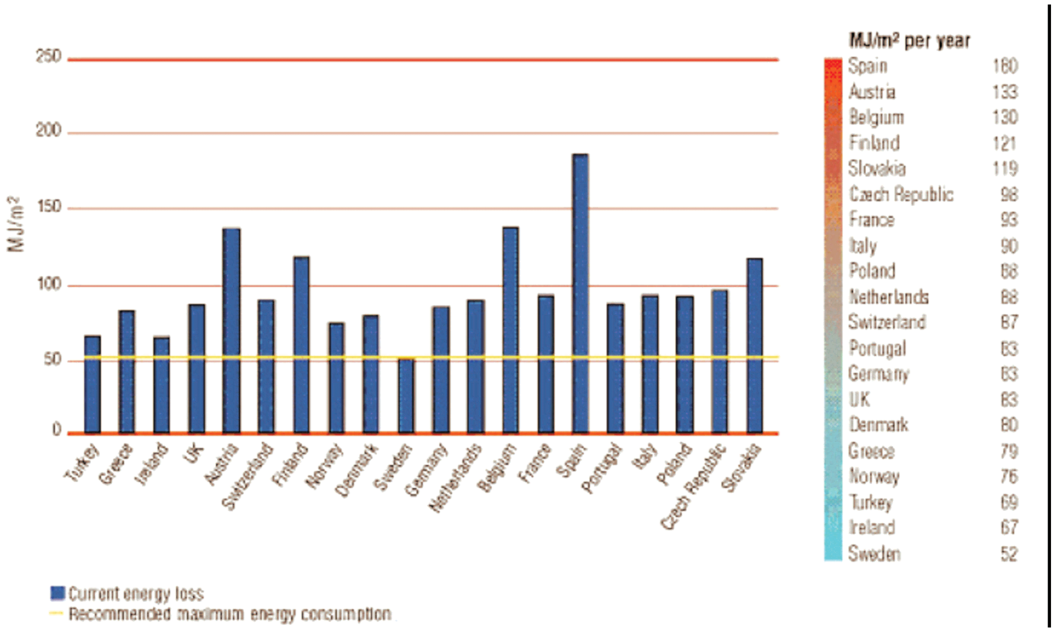
5.3.3 Thermal insulation levels in Europe

Eurima (European Association of Insulation Manufacturers) has tracked the development of thermal insulation standards for the past 20 years. The northern European countries, given the climatic conditions, have always had much higher levels of insulation thickness in walls and roofs. A more complex picture emerges when both population sizes and the effect of degree-days - essentially the number of days during the year when heating is required in each country - are taken into account when comparing energy emissions.

Sweden, for example, has the best-insulated buildings in Europe. If Swedish standards were applied across Europe, energy savings in excess of 50 per cent could be achieved.

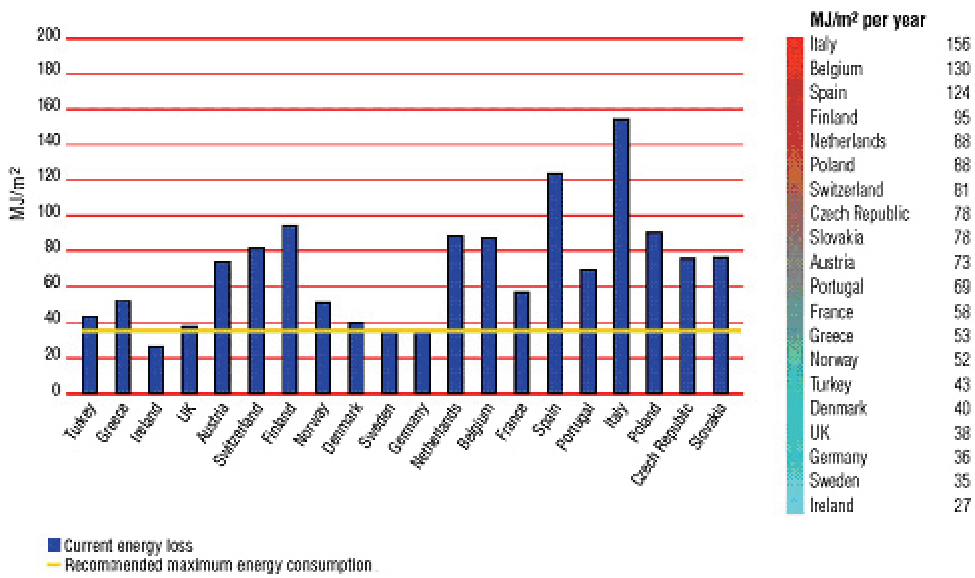
There still is potential for improvements in northern Europe, but massive emission reductions can be achieved by focussing on central and southern Europe (See Figures 5.4 and 5.5 below).

Figure 5.4: Energy loss through wall – Europe 2001



Source: Eurima (FAQs) http://www.eurima.org/facts_figures/faq.cfm

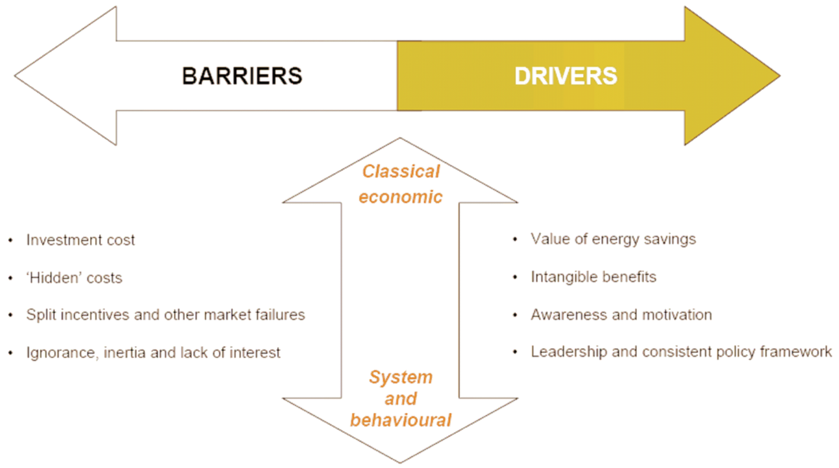
Figure 5.5: Energy loss through roofs – Europe 2001



Source: Eurima (FAQs) http://www.eurima.org/facts_figures/faq.cfm

Both drivers and barriers affect the take-up of energy efficiency measures (see Figure 5.6). In the case of thermal insulation products product awareness, lack of knowledge of the issue, price issue and skills shortage are the main barriers.

Figure 5.6: Barriers and drivers for take-up of thermal insulation



5.4 Impact of VAT reduction on product prices

5.4.1 Range of differences between low and high VAT rate among Member States

EU law has fixed VAT rates through the implementation of the VAT Directive (2006/112/EC). The reduced rate should be at least 5%. Currently only the UK has reduced rates on both thermal insulation product and services. Renovation and repair of private dwellings is one of the seven labour intensive services that may enjoy a reduced rate of VAT till 2010 (Annex IV of Directive 2006/112/EC). Twelve member states are presently using this option. In some cases renovation and repair involve installation of thermal insulation products but the reduced rate of VAT is only applied on the service.

In the UK, the government initially made the reduced rate available through special schemes, targeting vulnerable social groups. The lower rate VAT covers the installation of materials and the cost of the materials, but the lower rate is not available to DIY-ers, since materials have to be professionally installed to get the low VAT rate.

5.4.2 Evidence on 'pass through' of VAT

It is very difficult to judge the 'pass through' effect as in most cases the final consumers do not themselves buy the product. It is generally purchased by the installers. The margin for distributors of building products across EU is low (5-8%) which suggests a competitive market. A competitive market implies that there will be a full pass through effect. Growing sales of thermal insulation products have been accompanied by an increase in competition in the last five years. This implies that distributors and retailers would be inclined to pass on the VAT discounts to increase sales. The Commission also recognised that renovation and repair of private dwellings seems to be the sector in which providers most readily pass on the VAT reduction[31]. Thus we can assume 100% VAT pass through.

On the other hand, according to Eurima some of their studies have shown that retailers sometimes increase profit margins on these products, diminishing the share of the price reduction that reaches the consumer. However, this needs to be looked at more closely using appropriate quantitative and survey tools. Eurima also suggested that the impacts of VAT incentives may diminish over time, when consumers get used to reduced prices. In other words, the initial signalling effect of the lower price would diminish over time, especially as purchases of thermal insulation products tend to be on a “one off” rather than a regular basis.

The EC produced a report on the experimental application of a reduced rate of VAT to certain labour intensive services (European Commission, 2003). Nine of the EU-15 Member States chose to participate in the experiment (Table 5.2). Since the cost of the service for thermal insulation product is the biggest part of the final product the results of this experiment provide a useful insight on the impact of VAT reductions on end prices of thermal insulation products.

Table 5.2 Reduced rate of VAT on labour-intensive services for (EU-15) Member States concerned

1. Small repair services:	
- Bicycles	B, L, NL
- Shoes and leather goods	B, L, NL
- Clothing and household linen	B, EL, L, NL
2. Renovation and repair of private dwellings	B, E, F, I, NL, P, UK
3. Window cleaning	F, L
4. Domestic care services	EL, F, I, P
5. Hairdressing	E, L, NL

The member states surveyed above showed that renovation and repair of private dwellings was the only sector in which service providers most readily pass on the VAT reduction. This may be explained by the average scale of expenditure involved. However, it also found that where sectors — such as shoe, bicycle and clothing repair in the Netherlands and repairs of dwellings in France — pass on part of the reduction in VAT immediately, they tend subsequently to increase their consumer prices at a rate higher than inflation. Thus the application of a reduced rate only temporarily curbed the customary price increases. This is confirmed in Table 5.3 below as prices dropped temporarily when the measure came into force in 1999, but rose sharply the following year in two (Belgium & France) of the three Member States concerned.

[31] European Commission (2003).

Table 5.3 Harmonised consumer price index (annual growth rate in %)

	Belgium		Spain		France	
	All products	Home repair and main-tenance	All products	Home repair and main-tenance	All products	Home repair and main-tenance
1996	1.8	2.9	3.6	3.3	2.1	-
1997	1.5	0.4	1.9	2.6	1.3	1.9
1998	0.9	1.1	1.8	3.	0.7	1.6
1999	1.1	2.9	2.2	2.7	0.6	-0.5
2000	2.7	2.3	3.5	4.1	1.8	-3.5
2001	2.4	5.3	2.8	4.6	1.8	3.3

Source: Eurostat

5.5 Impact of price reductions on consumer demand

5.5.1 Direct impact of VAT reduction

Reduced VAT rates practically are almost identical to small subsidies for products and materials, which are known to lead to (at least initially) higher sales due to the improved cost-effectiveness of the products or materials, as well as the communicative value of subsidies and tax incentives (Eurima).

According the insulation industry in UK and mainland Europe, the reduced rate of VAT, if not a significant price incentive is definitely a strong sales tool.

Reduced VAT rates directly benefit private building owners and, in many countries in Europe, social landlords (which are VAT exempted). Further, as rents are often VAT-exempted, VAT incentives would also apply to many commercial landlords. Thus, a reduced rate of VAT on thermal insulation products would apply to almost all housing and a significant share of the non-residential building stock.

In many cases, since the installer buys the product for the final customer, the reduced VAT rate may not be clearly visible to the end consumer. This is one reason why the uptake by paying customers in the UK (other than social housing and priority groups) has been low. Even though the reduced vat rates apply to insulation service, it is not advertised in the same way as products.

B&Q, the largest home improvement and garden centre retailer in the UK and Europe and the third largest in the world, carried out an independent survey[32] of 1000 customers in 2002. The findings are given in box 5.2 below:

Box 5.2 Results from the B&Q survey

- 86% of people surveyed would be more likely to buy energy efficiency products if they were cheaper
- 64% feel that by buying energy efficiency products, they will make a real difference to the world's environmental issues
- 79% think they are doing their bit for the environment
- 34% had not bought any energy efficiency products

B&Q, in 2002 working with energy suppliers, TXU, and manufacturers, Knauf Alcopor, cut the price of loft insulation to the equivalent of it being VAT free for 2 weeks. The campaign led to an increase in sales by 120%[33]. This was a promotional scheme and though it provides a good indication of the price effect having an impact on demand it cannot be used to measure the price elasticity of demand due to the time limited nature of the discount.

Demand for energy saving materials depends on a whole package of measures as well as energy prices. The upfront costs of energy saving materials are very high compared to say A/A+ rated energy efficient appliances. The energy savings associated with the most efficient appliances mean that in some cases the life-cycle cost of the most efficient product is lower than that of a less efficient product, notwithstanding the higher initial outlay[34] required at the point of purchase. A consumer buying an energy efficient appliance takes this into consideration. In the case of energy-saving materials such as loft insulation, the initial outlay has to be compared against the 'payback period' only. Even though in both cases there is a 'payback period' for the additional investment, and this period is reduced by VAT reduction, in the case of thermal insulation it cannot be compared with a less efficient product. In other words a consumer buying a washing machine primarily buys the product to wash their clothes and may take account of the energy saving potential of the chosen product. In the case of energy saving materials, there may be less impetus to make the purchase due to the inertia caused by market failure (see section 5.7.2). This inertia may cause a failure to invest as there is no other reason to make the purchase apart from energy saving.

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[32] The survey was carried out by Taylor Nelson Sofres. 1003 adults aged 16+ were interviewed by telephone from 20th - 22nd September 2002. The sample was weighted to represent the population of Great Britain aged 16+.

[33] Distributed by PR Newswire on behalf of B&Q Stores - http://www.prnewswire.co.uk/cgi/news/release?id=92286

[34] Up to as much as three times more than they would be for the efficiency class that has the greatest market share (see Chapter 4).

Without the reduced rate of VAT the payback period ranges from 2 to 6 years and depends on domestic energy prices (Table 5.4). The payback period with the reduced rate of VAT (in the UK: 5%) falls by a number of months for all measures. With increasing gas prices the payback period could reduce even further assuming that any increase in demand does not increase the 'Installed' and 'DIY' cost. While we may expect the reduced payback period to have an impact on demand, it should be noted that the payback period on most insulating materials already provides a good bargain for the consumer. This apparent "inertia" may raise questions about the likely impact of marginal price changes.

Table 5.4 Key indicators relating to the use of energy-saving materials

Measure	**Cavity Wall Insulation**	**Internal Wall Insulation[1]**	**External wall Insulation[2]**	**Loft insulation (0-270mm)**	**Loft insulation (50-270mm)**	**Floor insulation[3]**	**Draught proofing**
Annual saving (£/yr)	£90	£300	£300	£110	£30	£45	£20
Installed cost £	Around £500	From £40/m2	From £1,900	Around £500	Around £500		Around £200
Installed payback	Around 5.6 years		From 6.3 years	Around 4.6 years	Around 16.6 years		Around 10 years
Installed cost £ (with 5% VAT)	Around £433		From £1646	Around £433	Around £433		Around £173
Installed payback (with 5% VAT)	Around 4.8 years		From 5.5 years	Around 3.9 years	Around 14.4 years		Around 8.7 years
DIY cost				From £250	Around £180	Around £90	Around £90
DIY payback				From 2.3 years	Around 6 years	From 2 years	Around 4.5 years
DIY cost (with 5% VAT)				From £217	Around £156	Around £78	Around £78
DIY payback (with 5% VAT)				From 2 years	Around 5.2 years	From 1.7 years	Around 3.9 years
Annual CO_2 saving	750kg	2.4 tonnes	2.5 tonnes	Around 1 tonne	250kg	370 kg/year	150 kg/year

[1]Assumes insulating to a u-value of 0.45 W/m²K.

[2]Assumes insulating to a u-value of 0.35 W/m2²K. Installed costs assume that walls are being repaired anyway and relates to the additional cost of insulation and labour. The full cost of installation (ignoring any remediation costs is typically in the region of £4,500 for a semi-detached house, with a payback of around 15 years).

[3]Floor Insulation represents the cost of the insulation only

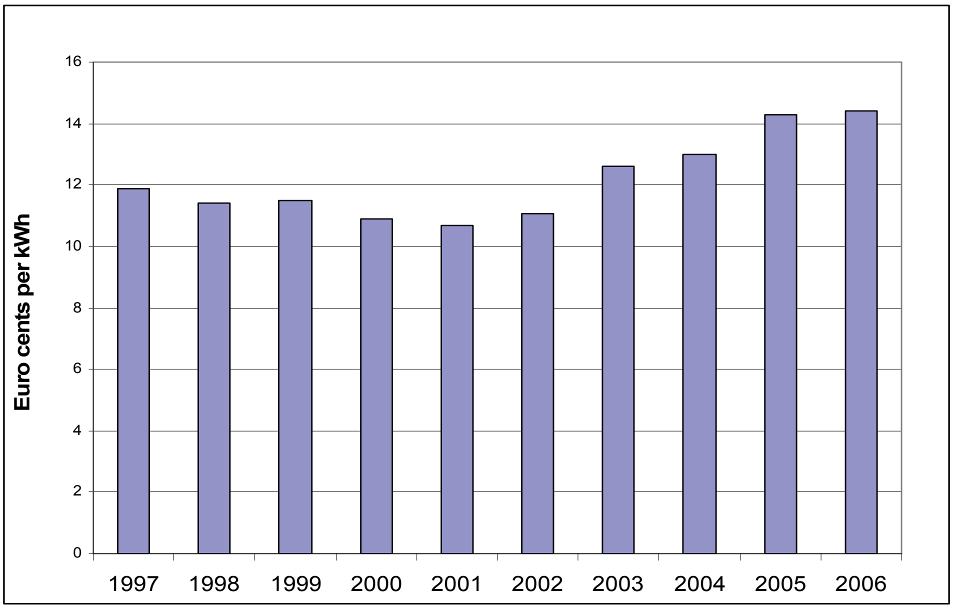
Source: Energy Savings Trust, UK

Note: All figures are based on a gas heated semi-detached house with 3 bedrooms. Savings assume a gas price of 2.51p/kWh.

5.5.2 Other factors incentivising consumer demand

There are other factors which are also driving demand for thermal insulation materials. Increases in energy prices (see Figure 5.7) are making energy saving measures more cost-effective and significantly reduce payback times.

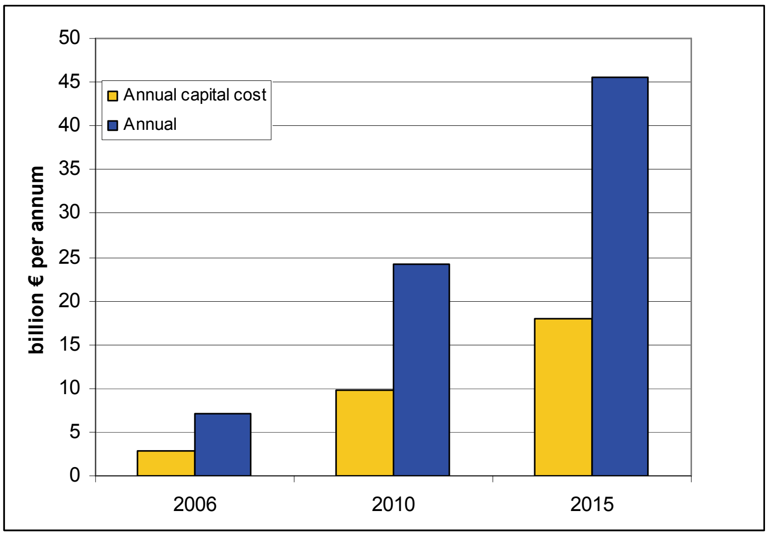
Figure 5.7 Domestic electricity prices in the EU 15 and the G7 countries



Source: BERR, UK

Ensuring that whilst buildings across Europe are being renovated, they also have their thermal performance upgraded, would save Europe EUR 14.6 billion a year by 2010, rising to 28.1 billion a year by 2015 in terms of energy costs (Figure 5.8). This saving includes the costs of labour and materials (Eurima). Please see Annex 5.A for more details.

Figure 5.8 Annual capital cost vs. annual energy cost savings (EU-25)



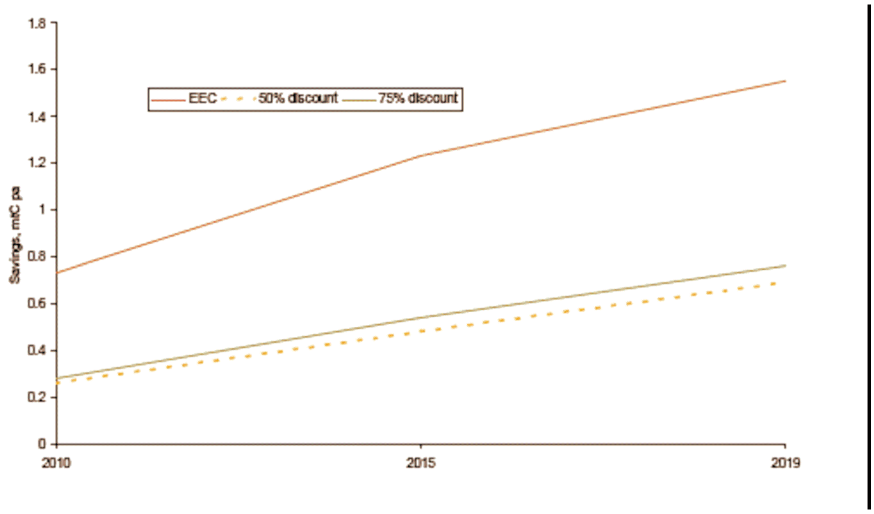
Source: Eurima (2006b)

The Energy Performance of Buildings Directive (EPBD) also aims to promote the improvement of the energy performance of buildings within the EU through cost-effective measures. Two of the main aspects to the EPBD that will affect the insulation market are:

- Minimum energy performance requirements: there must be regulations that set minimum energy performance requirements for new buildings and for large existing buildings when they are refurbished;
- Energy performance certificate: there must be an energy performance certificate made available whenever buildings are constructed, sold or rented out.

The UK Energy Efficiency Innovation Review (EEIR) found that consumer awareness is a key factor in delivering carbon savings. Their modelling shows that EEC[35] has a much greater carbon saving impact than the equivalent worth given as financial discount (see Figure 5.9 below). Therefore it appears that the awareness or marketing aspect of EEC plays a significant role in driving carbon saving.

Figure 5.9 Projected carbon savings from insulation measures for owner occupiers



The bulky nature and relatively low value of insulation of materials also makes them less susceptible to cross-border trading. The Copenhagen Economics (2007) study found that construction material did not experience cross-border shopping. Construction material share of total consumption purchased by Danish consumers (VAT rate 25%) in Germany (VAT rate 16%) was around 0.5%.

5.6 Impact on Industry

According to Eurima, the industry has been growing significantly in the last three years.

[35] The Energy efficiency commitment is an UK policy mechanism which has set targets on energy suppliers to achieve improvements in energy efficiency by promoting energy efficiency measures to households across Great Britain

In the UK, towards the end of Energy Efficiency Commitment (EEC) 2002-05, contractors reported high price increases from manufacturers, in particular for loft insulation materials although there were price rises for cavity wall insulation too. Increasing demand for insulation products (particularly loft insulation products) in the UK at the end of EEC 2002-05 meant that, for the first time in a number of years, manufacturers were at nearly full capacity. The rise in demand and prices meant that investment could be made in additional manufacturing capacity. Manufacturers are also facing steeply rising energy prices and, in such an energy intensive business, this is eating into already tight margins (energy prices typically make up over 50% of total manufacturing costs). Further price rises for installers are possible. For manufacturers who use gas in their production process (e.g. Knauf) this is thought to be more of an issue than for manufacturers that use coke (e.g. Rockwool).

Thus manufacturers are greatly relying on the government grants and energy supplier subsidies for continuing growth in the market.

As already mentioned before, the industry feels that the VAT discount would greatly help the insulation industry by increasing sales due to the improved cost-effectiveness of the products or materials, as well as the communicative value of subsidies and tax incentives.

Box 5.3 *Findings from interview with thermal insulation manufacturer 'Knauf Insulation' in Germany*

The interviewee agreed on the following statements:

- A reduced VAT on environmentally advanced products will change the price strategies of retailers
- A reduced VAT on environmentally advanced products will not change the price strategies of producers
- Reduced VAT or other financial incentives for environmentally advanced products will speed up market introduction of such products
- A larger demand for environmentally advanced products will have a positive effect on innovation rates in the sector
- A larger demand for environmentally advanced products will have a positive effect on profits of the sector

5.7 Assessing the impact of VAT differentiation

5.7.1 Quantitative assessment

Expected Change in Demand

Speaking to sector association and manufacturers both in UK and Germany has confirmed that price elasticities of demand cannot be calculated. However, we can assess the potential effects of alternative scenarios for the price elasticity of demand from the discussion in section 5.5.1.

Table 5.4 suggests that there is scope to increase demand, due to the favourable payback period. This is strong evidence that demand is limited not by financial factors but by general inertia and market failure. Most consumers are apparently unwilling to invest despite favourable financial outcomes. This in turn suggests that marginal price changes are unlikely to have a big impact and that we might expect demand to be inelastic.

We also assume a 100% VAT pass through effect due to the competitive nature of the thermal insulation market (as discussed in section 5.4.2).

From Table 5.1, we can calculate the effects of reduced VAT on the overall price of energy saving materials in the EU, given current VAT rates on insulation products. The weighted average reduction (based on domestic energy consumption by MS) in price is around 12.2% for EU-27 if all member states applied VAT at the reduced rate on thermal insulation products.

We also assume that demand is inelastic since most thermal insulation products have favourable payback periods and demand is not motivated by rational financial decisions (existence of inertia and market failure). The impact of a 12.2% reduction in price assuming three inelasticity scenarios is shown in Table 5.5 below.

Table 5.5 Change in Demand

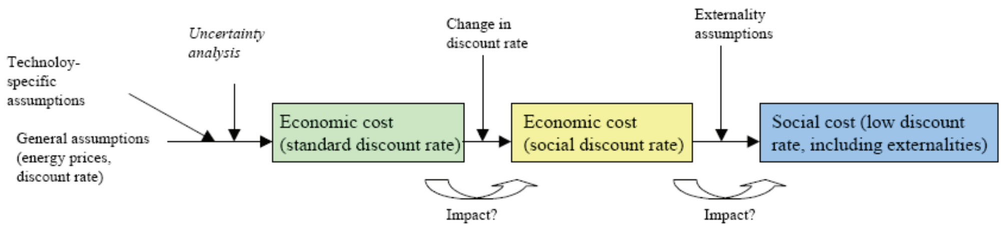
	Price elasticity of demand	Change in demand %	Increase in value of thermal insulation market € billion
Low	-0.25	3.0	0.9
Medium	-0.5	6.1	1.8
High	-1	12.2	3.7

According to Eurima, in 2007, the thermal insulation market (products only) in Europe was worth €30 billion. Based on the assumed elasticities in Table 5.5, a 12.2% price increase would be expected to increase demand for thermal insulation products in the EU between 3% and 12%. Based on current market value of €30 billion, this would involve an overall increase in the thermal insulation market of €1 billion to €3.7 billion.

Social cost-benefit analysis

Most cost-effectiveness and cost-benefit analysis of greenhouse gas reduction options, i.e. €/tCO_2 avoided, are undertaken without due regard for long-term social costs and benefits. A study by the Centre for European Policy Studies (CEPS, 2006) has incorporated ancillary long-term social costs and benefits of CO_2 reduction measures and proposed a framework for their integration in traditional cost-benefit analyses. The study is based on analysing the economic and social costs of a range of technologies (Figure 5.10), including both economic and social discount rates, to arrive at net social cost projections of CO_2 abatement options.

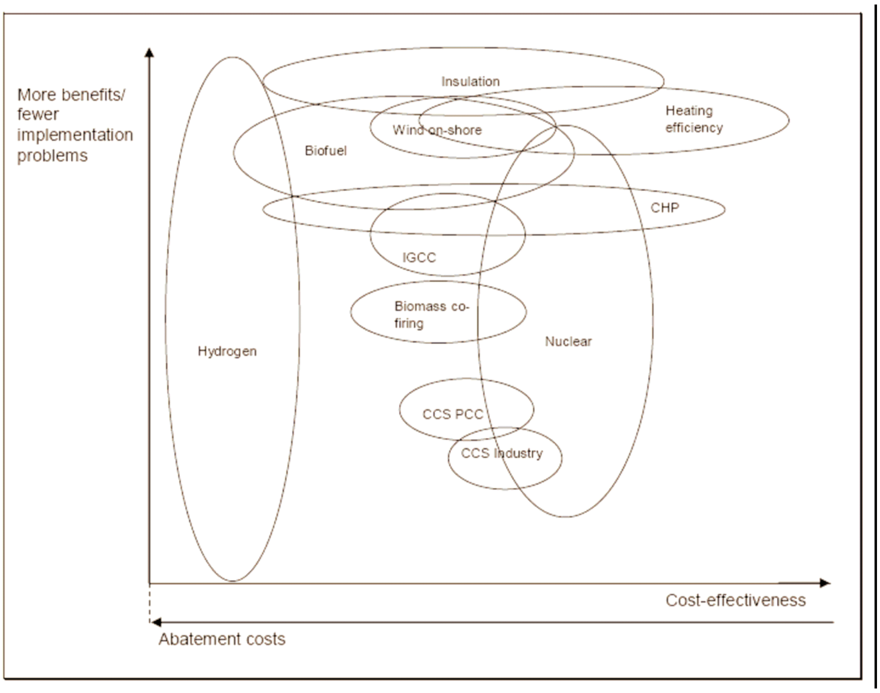
Figure 5.10 Costs and benefits of CO_2 reduction measures



Source: CEPS (2006)

Two key externalities, as part of the ancillary costs and benefits, are explicitly addressed in the calculations - i) impact on air pollution and ii) impact on long-term energy supply security risks. Based on the outcomes of the numerical model and additional qualitative information on the other prioritisation criteria, emanating from a literature scan, a broad classification of selected climate change options was made (Figure 5.11).

Figure 5.11 Broad classification of GHG mitigation options



Source: CEPS (2006)

Insulation was found to be highly cost-effective from the end-user point of view in reducing the emissions of GHGs and has some ancillary benefits for energy security and air quality, although the overall scale for achieving reductions is only medium if compared to some of the supply side options.

Expected Change in Environmental Impacts

No separate assessment exists on the contribution of the reduced VAT rate on energy saving. It is difficult to determine the impact of the VAT on energy saving materials in particular because it is a supporting policy measure and for example building regulations can have a more direct impact on energy and CO_2 reduction in the same projects.

However, from Table 5.4 we can assume that a typical thermal insulation installation costs €500 and saves around 1 tonne of CO_2 per year. As shown in Table 5.5, reducing VAT rates in Europe (EU-27) to the reduced rate can increase demand for thermal insulation products by €1 billion to €3.7 billion. This would lead to a reduction of between 1.8 Mt and 7.3 Mt of CO_2 per year.

Please see Annex 5.A for more details on the CO_2 reduction potential of insulation materials.

Impact on VAT Revenues

As shown in Table 5.1, the VAT rates vary significantly across all member states in EU. Also we were not able to obtain total sales of energy saving materials by member states. According to Eurima, in 2007, the thermal insulation market in Europe was worth €30 billion in product terms. Thus, a 10% VAT reduction on average would reduce VAT revenues by €3 billion (leaving aside the impact of increases in sales).

However, this would have to be compared against the reduced expenditure on energy, most of which in the next 10-20 years will be imported by Europe. Europe's energy demand is expected to grow by 50% by 2030. This growth is expected to lead to an increased dependence on foreign energy supplies. It is projected that by 2030, 70% of all Europe's energy may have to be imported.

In the UK, the 5% VAT rate on energy saving materials instead of the 17.5% standard rate cost the exchequer £50 million in 2006-07 and 2007-08.

Compliance and Administrative Costs

A reduced VAT rate is a simple measure, requiring no specific implemention measures besides the definition of a list of qualifying products and materials and the communication of this to suppliers. Special consideration should be given to the service cost of installing building materials and equipment. In most cases service cost of installing energy saving materials is more expensive than energy efficient building materials, and is also subject to VAT.

5.7.2 Qualitative assessment

Strengths of reduced rate of VAT on energy saving materials

- As building products and equipment, all subject to VAT, can have a considerable impact on the overall sustainability of the shell of a home, it is important to provide incentives to people to buy more sustainably.
- It has ancillary benefits for energy security and air quality, as well as job creation.
- Reducing VAT may make a significant contribution to tackling fuel poverty, by reducing the costs of heating homes. However, this impact is likely to be small compared to dedicated schemes to install free or subsidised energy saving materials, since poverty is a barrier to investing in energy saving measures.

Weakness of reduced rate of VAT on energy saving materials

The reduced rate of VAT is a supporting measure and requires other financial instruments, and regulations, to encourage energy efficient investments. It is also doubtful whether a reduced rate provides sufficient financial incentive to make a change. There is existing evidence of the cost effectiveness of investing in energy saving materials – even in the absence of VAT reductions – suggesting that demand is limited by inertia and that proactive action may be needed to have a significant impact. To increase its effectiveness and coherence, the VAT reduction could be supported with the introduction of a number of measures, such as :

- increasing VAT rates on domestic energy where it is currently taxed at reduced rate to alleviate fuel poverty.
- Government intervention to overcome market failures:
    - a distrust of information about energy efficiency opportunities from what consumers see as vested interests;
    - energy prices have been historically low, so consumers do not explore ways of reducing their bills. This is expected to change given the increase in energy price in recent times;
    - a lack of consumer interest in savings of this scale;
    - a lack of sufficient information for consumers about the benefits of energy efficiency;
    - the hassle – or perceived hassle – of having the work undertaken;
    - consumer misconceptions about cavity wall insulation and concerns about reliability of installer;
    - tackling the black market which would blunt any form of VAT incentive

5.8 Discussion and conclusions

Thermal insulation comes out as the best energy efficiency measure in terms of social cost-benefit analysis. It is a very cost-effective option from the end-user point of view in reducing the emissions of GHGs as it is available with current and simple technology that does not demand trade-offs against other risks.

The effects of reduced VAT rates are difficult to investigate separately, as this is often one instrument applied in combination with many others. However, with rising energy prices reduced VAT rates can help as a sales tool to incentivise demand.

A VAT incentive can be a powerful tool to encourage energy efficiency in Europe. It can help overcome market barriers and speed the transformation of markets for energy efficient products and materials, at no net cost to governments and society. It can provide the right signals across the supply chain to increase the production and consumption of energy saving materials.

Annex 5.A

Table 5.A1 Reduction of energy consumption for building heating through existing thermal insulation implemented since 1975 compared to the existing energy consumption and the fictitious energy consumption of the un-insulated Eurima building stock

Energy consumption and CO_2 emissions for building heating	Energy consumption 2002 of Building stock in Eurima countries	Scenario: Energy consumption of Building stock with no insulation	Consumption reduction through implemented insulation	CO_2 -emissions 2002 of Building stock in Eurima countries	Scenario: CO_2-emissions of Building stock with no insulation	CO_2-emission reduction through implemented insulation	Energy- and CO_2-savings compared to building stock with no insulation
	[TWh/a]	[TWh/a]	[TWh/a]	[Mt CO_2/a]	[Mt CO_2/a]	[Mt CO_2/a]	[%]
In the cool climatic zone	148	385	237	46	120	74	62
In the moderate climatic zone	2,077	3,624	1,547	624	1,089	465	43
In the warmer climatic zone	618	945	326	169	258	89	35
Total building stock Eurima	2,843	4,953	2,110	839	1,467	628	43

Europe's cool 'climatic zone' comprising Denmark, Finland, Norway and Sweden

Europe's moderate central climatic zone includes Belgium, Denmark, Germany, France, Great Britain, Ireland, Luxembourg, the Netherlands, Austria and Switzerland.

Europe's "warm climatic zone" comprising Greece, Italy, Portugal and Spain

Table 5.A2 Comparison of heating costs per square meter heated area before and after retrofitted thermal insulation without taking into account other energetic improvements.

Material	Heating costs without thermal insulation	Heating costs with thermal insulation	Reduction of heating costs	Specific Reduction of heating costs
	[EUR/m² a]	[EUR/m² a]	[EUR/m² a]	[%]
Model house, built before 1974				
One-family house	11	3	8	77
Multifamily house	6	2	5	75

Environmental impact and cost savings of changes in consumer demand

The environmental impact and cost savings of using thermal insulation measures such CWI and LI is shown in the Tables 5.A3 and 5,A4 below. Using appropriate fuel cost and carbon intensity factors, the costs and carbon emissions before and after installation are also determined. From these values, the energy, cost and carbon savings for each measure are calculated.

Table 5.A3 Savings due to cavity wall insulation for gas central heating

Period	Energy (MWh/yr)	Cost (£/yr)	Carbon (kgC/yr)
Pre 1976	6.878	201	357
1976 – 1983	4.071	119	212
Post 1983	2.502	73	130
Weighted average	6041	176	314

Source: DEFRA Illustrative matrix, 2007

These figures are combined into averages, weighted by the relative abundance of uninsulated walls for the three periods, using the following estimates from English House Condition survey and supporting data. Relative abundance of uninsulated walls for three periods: Pre 1976 - 78%, 1976–1983 - 8% and Post 1983 -14%.

Table 5.A4 Savings due to loft insulation (DIY) for gas central heating

Thickness	Energy (MWh/yr)	Cost (£/yr)	Carbon (kgC/yr)
0mm to 270mm	7.871	229.6	409.0
50mm to 270mm	2.263	66.0	117.6
100mm to 270mm	1.181	34.4	61.3
Weighted average	2.995	87.4	155.6

Source: DEFRA Illustrative matrix, 2007

6. Case study: Domestic energy

6.1 Introduction

Reducing the VAT rate on domestic energy in the past has largely been motivated by distributional concerns with some member states wishing to reduce the costs of heating and electrical energy which account for a larger share of the total budget of low income families.

However, the original rationale for reducing VAT does not seem to hold as studies show that poorer households benefit less from energy subsidies compared to richer households. This is discussed in more detail in section 6.1.2. Moreover, a reduced rate of VAT on energy does not sync with a number of economic instruments, such as carbon/energy taxes and the emissions trading scheme, which have been introduced to reduce energy consumption.

6.1.1 Case study context

This case study considers two policy options:

- increasing VAT on domestic energy to standard rate in those MS where it is currently taxed at a reduced rate, to better reflect the externalities of energy consumption;
- lowering VAT to the reduced rate for renewable sourced electricity where it is taxed at the standard rate.

6.1.2 Increasing VAT on domestic energy to standard rate in those MS where it is currently at a reduced rate

Several EU Member States apply reduced VAT rates to energy products such as coal, heating oil, natural gas and electricity. Such schemes imply a subsidy to the final users of these products, as they effectively lower the price of energy as well as generate additional CO_2 emissions. Currently 10 member states have a reduced rate of VAT on domestic energy in Europe (see Table 6.1).[36]

[36] The case study focuses on natural gas and electricity. It should be noted, however, that in some MS coal and heating oil are also taxed at a reduced VAT rate.

Table 6.1: VAT rates on domestic energy in EU-27

			VAT rate on Natural gas		VAT rate on Electricity		Standard Rate of VAT
1	Belgium	BE	21		21		21
2	Bulgaria	BG	20		20		20
3	Czech Republic	CZ	19		19		19
4	Denmark	DK	25		25		25
5	Germany	DE	19		19		19
6	Estonia	EE	18		18		18
7	Greece	EL	9		9		19
8	Spain	ES	16		16		16
9	France	FR	19.6	5.5	19.6	5.5	19.6
10	Ireland	IE	13.5		13.5		21
11	Italy	IT	10		10		20
12	Cyprus	CY	5		15		15
13	Latvia	LV	5[a]	18	18	5[d]	18
14	Lithuania	LT	18		18		18
15	Luxembourg	LU	6		6		15
16	Hungary	HU	5		20		20
17	Malta	MT	-[b]	18[c]	5		18
18	Netherlands	NL	19		19		19
19	Austria	AT	20		20		20
20	Poland	PL	22		22		22
21	Portugal	PT	5		5		21
22	Romania	RO	19		19		19
23	Slovenia	SL	20		20		20
24	Slovakia	SK	19		19		19
25	Finland	FI	22		22		22
26	Sweden	SE	25		25		25
27	United Kingdom	UK	5		5		17.5

[a] To natural persons for private consumption
[b] When supplied by public authority – outside the scope of VAT
[c] When supplied in cylinders – 18%
[d] To natural persons for private consumption

Main reasons for existing reduced rate of VAT on domestic energy

The introduction of reduced VAT rates on energy has generally been motivated by social considerations, in much the same way as low VAT on other 'basic needs' such as food. For the energy sector this has been implemented primarily in response to increasing public concern around rising energy prices, in order to protect poorer households. This has particularly been a problem in the UK that is much less serious in other European countries. The term 'fuel poverty' is used to describe a situation whereby a household would need to spend more than 10 per cent of its income on heating in order to obtain an adequate level of warmth. A major contributing factor to fuel poverty is the poor thermal characteristics of the UK housing stock. It is because of a desire not to exacerbate fuel poverty that the present UK government has made a repeated commitment not to tax the household use of energy.

However, a case study on Poland in IEEP *et al.* (2007) suggests this initial rationale was not fully valid as poor households in Poland benefited less than richer ones from the energy subsidies because they typically use less energy in both absolute terms and relative to income. For example, Freund and Wallich (1997) found that the poorest 20% of the Polish population spent 7.4% of their total expenditure on energy, compared to more than 10% for the richest 40%. However, this would not apply in all member states and is more true in countries where gas and electricity are a relative luxury.

The Polish example was selected because the reduced rate of VAT has since been removed. The analysis of subsequent changes in consumer prices has shown that market fluctuations and the relaxation of price controls have been more significant determinants of consumer energy prices than changing VAT rates. Furthermore, compensatory measures were introduced for the poorest households and pensioners to help acceptance of the removal of reduced VAT rates, despite only applying to 1% of all households. The compensatory measures included direct allowances as well as cheap credit to finance the modernisation of local heating sources, which demonstrated that government support could be redirected to protect poorer households in a more efficient way than through reduced VAT rates.

The report considers the removal of reduced VAT rates on domestic energy in Poland to have been successful. This is partly because the timing coincided with a period of favourable economic conditions with falling inflation and rising disposable incomes, which offset the impact of the VAT increase. However the Czech Republic provides an example where a similar reform was achieved during a recession.

6.1.3 Economic implications of lower rate of VAT on domestic energy

Reduced VAT rates for domestic energy imply a subsidy to the final users of these products, as they effectively lower the price of energy (assuming that the energy supplier does not have the market power to prevent this).

IEEP *et al.* (2007) explore the definition, quantification and potential for reform of environmentally harmful subsidies (i.e. ‘a subsidy that encourages more environmental damage to take place than what would occur without the subsidy’, OECD, 1998b), using case studies to offer practical insights. One case study focuses on the energy sector and looks at the potential for the removal of reduced rates of VAT on energy products in the household sector.

The report identifies a number of definitions of subsidies, relevant to specific sectors, and suggests an energy subsidy, as defined by the International Energy Agency (2002) and the OECD (2005), comprises ‘any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers’. Furthermore, a reduced rate of VAT on energy is considered an ‘off-budget’ subsidy, defined as ‘a transfer that does not appear on national accounts as government expenditure’.

The OECD (2005) suggests that an environmentally harmful energy subsidy depends on whether the energy source supported by the subsidy causes more or less harm than an alternative energy source (i.e. subsidies that support fossil fuels typically represent greater threats to the environment than those that aid renewable energy sources).

It is estimated that the subsidies due to VAT reduced rates for EU households amount to €7.3 billion, so distributed: €65.6 million for solid fuels, €114.1 million for fuel oil,

€2130.7 million for natural gas and €5008.7 million for electricity (estimates based on Eurostat and OECD data, 2004).

The total value of the subsidy is shown in Table 6.2. This is quantified by the loss of revenue resulting from the fact that households' energy use is taxed at a reduced rate rather than at each country's full rate of VAT.

In particular, the UK provides a significant level of support for the use of gas in households through VAT reduced rates (5%) (the subsidy amounts to around €1.9 billion). The UK is at the forefront for VAT tax exemptions to households not only for oil and gas but also for electricity (€2.4 billion annual subsidy), and is the country that grants the highest amount of subsidies through VAT low rates to solid fuels (€54 million). As for VAT reduced rates to electricity, the UK is followed by Italy, which grants €1.5 billion in VAT reduced rates to households.

Table 6.2: Annual subsidy amounts implicit in VAT reductions for energy use in households in EU countries (source: IEEP et al., 2007)

		VAT rate (%)	Standard VAT rate (%)	Subsidy (€million)
Belgium	Solid fuels	12	21	6.7
Estonia	Solid fuels	5	18	0.5
Greece	Natural gas	9	19	4.3
	Electricity	9	19	239.0
	TOTAL			***243.2***
Hungary	Solid fuels	15	20	1.2
Ireland	Solid fuels	13.5	21	11.5
	Fuel oil	13.5	21	30.6
	Natural gas	13.5	21	52.9
	Electricity	13.5	21	152.1
	TOTAL			***247.1***
Italy	Solid fuels	10	20	0.3
	Natural gas (1)	10	20	114.2
	Electricity	10	20	1532.9
	TOTAL			***1647.4***
Luxembourg	Solid fuels	12	15	0.0
	Fuel oil	12	15	2.7
	Natural gas	6	15	12.5
	Electricity	6	15	25.9
	TOTAL			***41.1***
Malta	Electricity	5	18	10.5
Portugal	Fuel oil	12	21	26.5
	Natural gas	5	21	39.0
	Electricity	5	21	556.7
	TOTAL			***622.3***
United Kingdom	Solid fuels	5	17.5	45.3
	Fuel oil	5	17.5	54.4
	Natural gas	5	17.5	1907.8
	Electricity	5	17.5	2491.6
	TOTAL			***4499.0***
TOTAL EU	***Solid fuels***			***65.6***
	Fuel oil			***114.1***
	Natural gas			***2130.7***
	Electricity			***5008.7***
	TOTAL			**7319.0**

Data sources:

Energy use: Eurostat, Energy: Yearly Statistics 2004; natural gas and electricity prices: Eurostat, database energy prices (average for 2004); fuel oil and coal prices: OECD, Energy prices and taxes; data for 2004.

Assumptions:

- Calculations used figures for energy use relating to households plus the services sector. As VAT is deductible for part of the services sector, this gives a slight overestimation.

- Calculations used prices based on unweighted averages for all household user categories.

- In the case of natural gas and electricity prices, where national data is lacking, the EU average was used.

- In the case of fuel oil and coal prices, where national data was missing, the prices of nearest EU country for which data were available were used (i.e. Poland in case of Estonia; UK in case of Ireland; Austria in case of Italy).

Note (1): Reduced VAT rate applies only to natural gas for cooking and water heating in the southern part of Italy; it was estimated that this is 10% of total natural gas use in Italy by households and services.

6.2 Assessing the impact of VAT differentiation

6.2.1 Quantitative assessment

Price elasticities and demand responsiveness

The expected change in demand can be calculated using price elasticities of demand for domestic energy. From the literature, the price elasticity for domestic electricity was estimated to be around –0.30 (with little variation between European countries), which shows a moderate responsiveness of electricity consumption to changes in prices. This indicates a price-inelastic demand for electricity. Similarly the price elasticity of demand for natural gas was around -0.35, although from fewer sources.

Table 6.3: Estimates of domestic energy price elasticity of demand

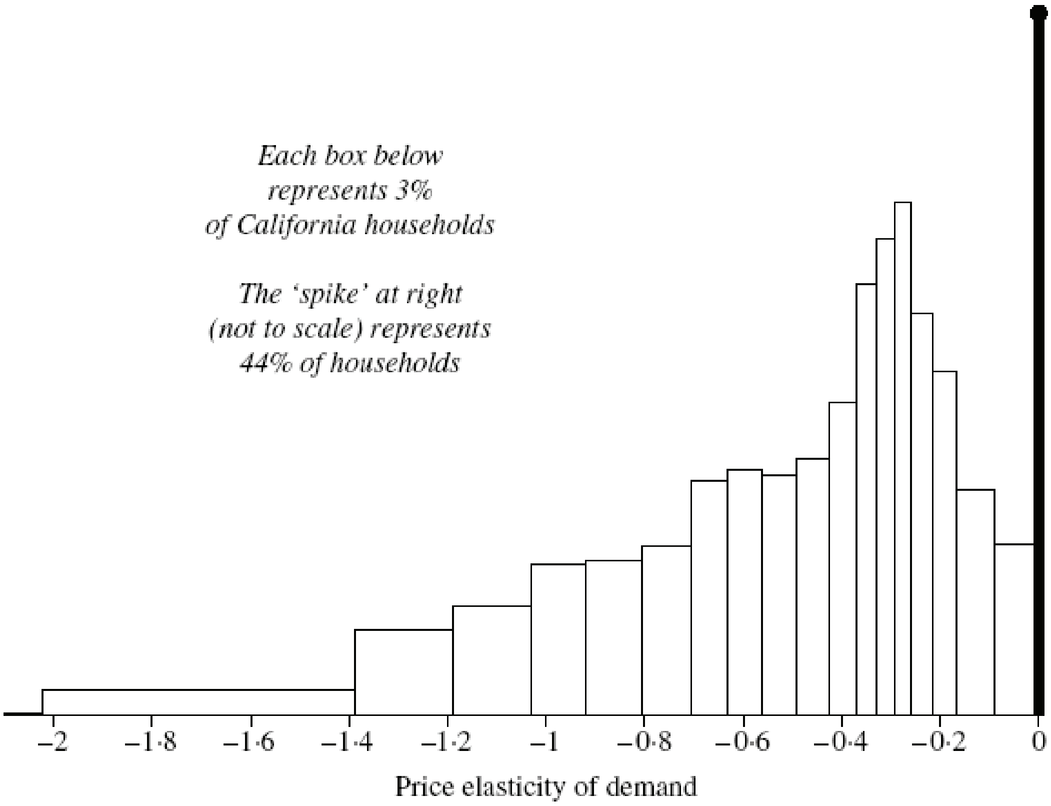
Source	Electricity	Gas
Department for Trade and Industry UK	-0.30	-0.35
Filippini (1999), Switzerland	-0.30	
Böheim (2005), Austria	-0.25 to -0.30	
Grohnheit and Olsen (2000), Denmark	-0.30	
NREL (2006), US	-0.32	-0.36

The (absolute value of the) price elasticity of demand for domestic energy has fallen over time. Studies in the 1970s and 1980s found them to be around –0.50 to –0.70. This fall can be attributed to more energy efficient products, competitive markets and greater use of thermal insulation products, as well as rising incomes which mean that a larger proportion of households are able to use the energy they need, irrespective of price.

Long term elasticities of demand for energy tend to have higher (absolute) values than short term elasticities. For example, Rapanos and Polemis (2005) estimated for Greece a short-run price elasticity of demand for residential energy of –0.31, and a long-run elasticity of –0.60. This can be explained by time lags caused by the life cycle of energy using appliances: most consumers will not buy a more energy efficient appliance immediately after a jump in energy prices, but do so at a 'natural' replacement moment after some time. Likewise, the impact of higher energy prices on decisions regarding fuel substitution and energy saving measures is also likely to become visible only after some time.

Average elasticity figures hide the large differences that may exist between households. By way of illustration, Figure 6.1 shows the estimated distribution of (short term) price elasticities among households in California. It appears that, while on the one hand 44% of the households does not exhibit any short term price responsiveness (i.e., elasticity is zero), on the other hand some 10% of the households has an elastic demand (elasticity < -1).

Figure 6.1. Distribution of shorte term price elasticities of demand among households in California (Source: Reiss and White, 2005)



Expected Change in Demand

Keeping in mind the limitations of using single demand elasticity figures, we can make a tentative estimate of the impact of levying VAT on domestic energy at the standard rate in all EU Member States. From Table 6.1, there are 10 MS with reduced rate of VAT on domestic energy. The estimated impact on energy consumption from the reduced rate rather than each country's full rate for 2005 is shown in Table 6.4 below. Assuming price elasticities of –0.3 for electricity and –0.35 for gas, consumption would have been lower by 3% and 4% respectively if domestic energy was taxed at the standard rate of VAT.

Table 6.4: Environmental impact of reduced rate of VAT on domestic energy for selected member states

2005		Electricity Consumption	Gas consumption	Reduction in consumption if std. vat rate were applied				CO2 Savings if std. vat rate were applied	
				Electricity		Gas		Electricity	Gas
		Gwh	Gwh	Gwh	%	Gwh	%	Mil Tonnes	Mil Tonnes
Greece	EL	36,286	1,900	-1,008	-3%	na		-0.53	na
Ireland	IE	16,620	11,758	-312	-2%	-272	-2%	-0.16	-0.05
France	FR	276,418	264,302	-8,862	-3%	-11,106	-4%	-4.67	-2.05
Italy	IT	146,199	342,483	-3,206	-2%	-7,017	-2%	-1.69	-1.30
Cyprus	CY	na	na	na	na	na	na	na	na
Latvia	LV	3,881	2,733	-128	-3%	-105	-4%	-0.07	-0.02
Luxembourg	LU	2,084	3,317	-49	-2%	-99	-3%	-0.03	-0.02
Hungary	HU	21,969	82,890	na	na	-3,780	-5%	na	-0.70
Portugal	PT	28,678	4,411	-1,309	-5%	-235	-5%	-0.69	-0.04
United Kingdom	UK	217,802	488,571	-7,786	-4%	-20,345	-4%	-4.10	-3.76
Total		**749,937**	**1,202,366**	**-22,660**	-3%	**-42,959**	-4%	**-12**	**-8**

Note: Cyprus and Hungary have reduced rates of VAT only on natural gas
Source: Eurostat

Environmental impact of reduced rate of VAT on domestic energy

Table 6.4 shows that overall nearly 20 million tonnes of CO_2 could have been avoided in 2005 if the VAT rates were at each country's standard rate.

6.2.2 Qualitative assessment

Main reasons for increasing VAT rates on domestic energy where currently taxed at reduced rates

- To encourage energy efficiency;
- The initial rationale, for a reduced rate of VAT on domestic energy, of protecting poorer households is not valid as fuel poverty is best addressed through other targeted measures
- Household energy consumption is growing and forecast to grow at higher rates.

A number of fiscal instruments have been introduced to reduce energy use.

Some Member States have introduced carbon/energy taxes on households to incentivise efficient energy use. The four Nordic countries, Germany, the Netherlands and Italy all introduced carbon taxes on household energy during the 1990s. Such a tax is highly desirable for environmental reasons but is financially regressive since domestic energy is a necessity good. Not only do poorer households, on average, spend a greater proportion of income on energy but they are also less able and willing to reduce their consumption by switching inputs (e.g. by purchasing more efficient appliances, increasing home insulation, or switching to cleaner fuels, etc). This is because of capital constraints and the fact that those on low incomes are more likely to reside in rented accommodation. As a result a domestic energy tax predominantly falls on the poorest households.

More cost-effective ways of tacking fuel-poverty

Fuel poverty, where a household needs to spend more than 10% of its income on heating in order to obtain an adequate level of warmth, is a major issue in the UK affecting more than nine million households according to Friends of the Earth. The issue is typically much less significant in other EU countries and a major reason for the problem in the UK is the poor thermal efficiency of UK housing stock. The social effects of a cabon/energy tax could lead to increased discomfort and serious health problems for these poorest households.

It is therefore important that additional revenue raised through a tax on domestic fuel usage is used to protect these most vulnerable groups, by ensuring they are not financially worse off and thereby does not increase fuel poverty. This occurs through automatic recycling, as energy prices are used to calculate levels of benefit and state pensions, so an increase in energy prices will lead to an increase in benefits. Since poorer households typically receive a higher proportion of their income in the form of these indexed benefits, the impact will be progressive.

A number of studies have looked at the effectiveness and efficiency of different ways of recycling revenues to compensate low income groups. The most successful approaches to achieve efficiency, equity and environmental goals will change the way households respond to changes in market prices as well as changing the market prices themselves. For example, Barker and Johnstone (1997) analysed the distributional effects of two different strategies – the first option included the introduction of a carbon/energy tax and a standard lump sum payment to compensate low income households for any losses, while the second option included the carbon/energy tax with a government sponsored home insulation programme for low income households. Although both measures were found to be progressive, the first option requires the government to pay indefinitely for continued inefficient energy consumption, while the second option encourages conservation and reduced compensation payments. The study indicated that a net increase in disposable incomes was expected in five years, which suggests that it is possible to not only protect poor households but also ensure they can benefit from a more efficient use of energy.

However, research undertaken by the Joseph Rowntree Foundation (JRF, 2004) found that energy use in the UK also varies significantly between households with similar incomes. The research assessed the impacts of a range of different compensation packages on low income households including means-tested benefits, child benefit, adjustments to pensioners' Winter Fuel Allowance (WFA) and modifying carbon/energy taxes. None of the packages were found to be able to provide effective compensation for all, with each leaving some low income households significantly worse off. The current UK policy of subsidising the installation of energy efficient measures is aimed at households in fuel poverty and will therefore leave most houses as inefficient users of energy, resulting in increasing carbon emissions.

An alternative approach would be to incentivise the installation of energy-efficient measures in non-fuel poor households by imposing a 'climate change' surcharge. In order to avoid paying the surcharge, households would need to have an energy audit of their home to identify all cost-effective measures that would need to be implemented within a specified period of time. To overcome potential issues of a lack of trained installers, the scheme could be implemented over time, starting with those best able to afford the improvement measures, i.e. starting with the highest council tax bands and giving prior warning others.

Research suggests that much of the investment in household energy efficiency is cost-effective and cost savings would be significant for most households. The JRF research estimates that such a scheme would abolish fuel poverty in the UK, increase energy-efficiency of UK housing stock to similar levels with other European countries, achieve savings of 4 million tonnes of carbon over ten years and save households a net present value of approximately £20 billion on an investment of £6.4 billion. This approach would also eventually permit a non-regressive carbon tax to be imposed.

To harmonise the VAT treatment of energy and energy saving goods and services in MS where the former is taxed at lower rate than the latter

A number of EU countries have abolished VAT reduction for energy products in the past, for various reasons. Table 6.5 provides an overview of VAT reduction schemes for energy products that have been removed and others that still exist.

Table 6.5: Reduced VAT rates for energy products in EU Member States – past and present (households only)

Schemes that have been removed					
Member State	**Reduced rate applied to:**				**Year of removal / remarks**
	Coal	**Fuel Oil**	**Natural Gas**	**Electricity**	
Austria	X	x	x	x	1983
Belgium		x	x	x	1980-1983. A slightly reduced 'parking rate' (17 instead of 19%) continued to exist until 1992.
Czech Republic	X	x	x	x	1994-1997
Greece	X	x	x		1992. For natural gas, the reduced rate was re-introduced in 1998.
Hungary		x	x	x	2003-2005
Italy		x	x		1984-1988. Reduced rate for natural gas for cooking and water heating continues to apply to southern Italy.
Poland	X	x	x	x	1998
Portugal		x			1996. Reduced rate was re-introduced in 2001.
Slovakia	X	x	x	x	2003

Schemes that continue to exist					
Member State	**Reduced rate applied to:**				**Remarks**
	Coal	**Fuel Oil**	**Natural Gas**	**Electricity**	
Belgium	x				
Cyprus			x		
Estonia	x				
France			x	x	Only on standing charge
Greece			x	x	
Hungary	x				Allowed until end of 2007
Ireland	x	x	x	x	'Parking rate' (13.5%)
Italy	x		x	x	Natural gas: only for cooking and water heating in southern Italy
Luxembourg	x	x	x	x	Coal and fuel oil: 'parking rate' (12%)
Malta				x	
Portugal		x	x	x	
United Kingdom	x	x	x	x	

Source: IEEP *et al.* (2007), based on: OECD: Energy Prices and Taxes (various issues); European Commission (2006); Speck et al. (2001); Cnossen (1998).

6.3 Case for lowering VAT to reduced rate for renewable sourced electricity where it is taxed at standard rate

There is a case for having reduced rates of VAT on renewable sourced electricity which is less polluting than fossil fuel sources. Its main advantage would be that it would incentivise renewables compared to conventional sources. It could also reduce or close the price gap as renewable tariffs tend to be more expensive.

On the other hand it does less to encourage energy efficiency and its impact will have to be analysed in combination with other incentives provided for renewables, such as the EU Emissions Trading scheme and the Renewables Obligation Certificates.

It should also be pointed out that in this case a reduced rate of VAT is applied on a green variant of a product based on its source of supply. This is different to the other case studies where the green variant was based on the characteristics of the end-product.

6.3.1 Impact of reduced rate of VAT on renewably sourced electricity on consumer demand and environment

The European Commission's White Paper for a Community Strategy sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the European Union by 2010 (from the present 6% to 12%) including a timetable of actions to achieve this objective in the form of an Action Plan. The main features of the Action Plan include internal market measures in the regulatory and fiscal spheres; reinforcement of those Community policies which have a bearing on increased penetration by renewable energies; proposals for strengthening co-operation between Member States; and support measures to facilitate investment and enhance dissemination and information in the renewables field.

Eurostat provides historical data on domestic electricity consumption by member states but does not distinguish between renewable and non-renewable. To illustrate the impact on CO_2 emissions of a reduced rate of VAT on renewable electricity only, we have calculated renewable consumption using electricity generated from renewable sources as % of gross energy consumption (Table 6.6).

Table 6.6: Increase in renewable consumption if taxed at reduced rate of VAT

2005		Household electricity consumption	share of renewables		Elec price for renewables inc. tax (at current rate of VAT)	Elec price for renewables with reduced rate	Increase in consumption of renewables	CO2 emission savings
		Gwh	GWh	%[a]	€ cents/ kwh	€ cents/ kwh	GWh	Mil tonnes
Belgium	BE	39,084	1,094	3%	14.8	13.1	39	0.02
Bulgaria	BG	15,427	1,820	12%	6.4	5.7	62	0.03
Czech Republic	CZ	29,965	1,348	5%	8.7	7.6	50	0.03
Denmark	DK	22,878	6,452	28%	22.8	20.3	207	0.11
Germany	DE	269,200	28,266	11%	17.9	16.2	798	0.42
Estonia	EE	3,759	41	1%	6.8	6.0	1	0.00
Ireland	IE	16,620	1,130	7%	14.4	14.4	-	-
Greece	EL	36,286	3,629	10%	6.9	6.9	-	-
Spain	ES	131,823	19,773	15%	11.0	10.1	460	0.24
France	FR	276,418	31,235	11%	11.9	10.6	1,052	0.55
Italy	IT	146,199	20,614	14%	19.7	19.7	-	-
Cyprus	CY	3,383	-	0%	10.7	9.8	-	-
Latvia	LV	3,881	1,878	48%	8.3	7.3	65	0.03
Lithuania	LT	5,041	197	4%	7.2	6.3	7	0.00
Luxembourg	LU	2,084	67	3%	14.8	14.8	-	-
Hungary	HU	21,969	1,011	5%	10.6	9.3	38	0.02
Malta	MT	1,186	-	0%	7.6	7.6	-	-
Netherlands	NL	61,314	4,599	8%	19.6	18.0	106	0.06
Austria	AT	29,491	16,928	57%	14.1	13.1	364	0.19
Poland	PL	53,531	1,552	3%	10.6	9.3	57	0.03
Portugal	PT	28,678	4,588	16%	13.8	13.8	-	-
Romania	RO	13,800	4,940	36%	7.8	7.1	131	0.07
Slovenia	SI	5,372	1,300	24%	10.3	9.3	39	0.02
Slovakia	SK	11,244	1,855	17%	13.4	12.3	44	0.02
Finland	FI	37,026	9,960	27%	10.6	9.4	329	0.17
Sweden	SE	70,999	38,552	54%	14.0	12.3	1,397	0.74
United Kingdom	UK	217,802	9,365	4%	8.8	8.8	-	-
Total		**1,554,460**	**212,197**				**5,247**	**2.76**

Source: Eurostat
Note: [a] Electricity generated from renewable sources - % of gross electricity consumption
The dashes show no change as renewable electricity is already taxed at the reduced rate of VAT for that member state.

Given 2005 consumption levels for renewable electricity and applying the appropriate reduced rate of VAT for each member state would increase the demand for renewable electricity by 2.5% across Europe. We assume the price elasticity of demand for renewable electricity as -0.3 as presented in Table 6.3 for overall electricity. The total theoretical emissions savings can be calculated by estimating the total possible electrical output multiplied by an emissions factor for the counter factual case. This comes to around 2.76 million tonnes of CO_2, if the same quantity of energy were to be generated from the existing electricity grid mix.

6.3.2 Factors affecting demand for 'green' electricity

The above analysis is conservative in nature due to the lack of information on cross-price elasticities of demand for renewable energy. With increasing public awareness of the environmental impact of energy use more and more consumers are choosing green electricity. According to the Eurobarometer survey (64.2) conducted in all EU-25 Member States in autumn 2005 a significant percentage (40%), most likely individuals who are more sensitive to environmental issues, would be prepared to pay more for energy from renewable sources (see Table 6.7). 27% were willing to pay up to 5% more for green electricity, and 13% were willing to pay at least 6% more. Respondents in the 'old' EU-15 are more willing to pay higher prices for green electricity compared to the ten new members.

Table 6.7 Would you be prepared to pay more for energy produced from renewable sources than for energy produced from other sources? If yes, how much would you be prepared to pay? (in % of respondents)

	EU-25	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV	LT	LU
No, I am not prepared to pay more	54	54	55	39	56	54	59	45	47	57	58	57	70	73	35
Yes, I would pay up to 5% more	27	29	27	29	29	25	26	33	31	24	25	24	21	14	31
Yes, I would pay 6 to 10% more	11	13	11	22	12	11	11	6	13	7	6	10	5	3	22
Yes, I would pay 11 to 25% more	2	2	1	4	1	2	1	2	4	2	2	2	0	1	3
Yes, I would pay more than 25% more	0	1	0	2	0	-	1	0	0	1	0	0	-	0	3
Do not know	6	1	5	5	2	8	2	14	4	10	9	6	3	9	5

	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK	BG	HR	RO	TR
No, I am not prepared to pay more	66	65	45	52	67	70	55	76	47	50	45	76	53	64	54
Yes, I would pay up to 5% more	21	22	29	32	16	21	26	15	37	26	24	8	23	15	12
Yes, I would pay 6 to 10% more	7	5	18	9	8	3	12	5	13	18	17	1	13	3	3
Yes, I would pay 11 to 25% more	0	0	2	1	1	1	1	1	1	4	2	-	3	0	1
Yes, I would pay more than 25% more	0	-	1	1	0	-	0	-	1	0	1	1	2	-	1
Do not know	5	8	4	5	8	6	6	3	1	2	10	13	7	18	29

Source: Eurobarometer 64.2 (Attitudes towards Energy), European Commission, 2005.

Source: Eurobarometer 64.2 (Attitudes towards Energy), European Commission, 2005.

Several other studies have estimated consumers' willingness to pay for 'green' electricity. A survey among Texas residents by Zarnikau (2003) found that about 50% of respondents indicated a willingness to pay at least $1 per month more to support utility investments in renewable energy and/or energy efficiency. If we assume that the average US household uses some 5000 kWh per year, this would imply an average WTP of USD 0.0024 (EUR 0.0016) per kWh.

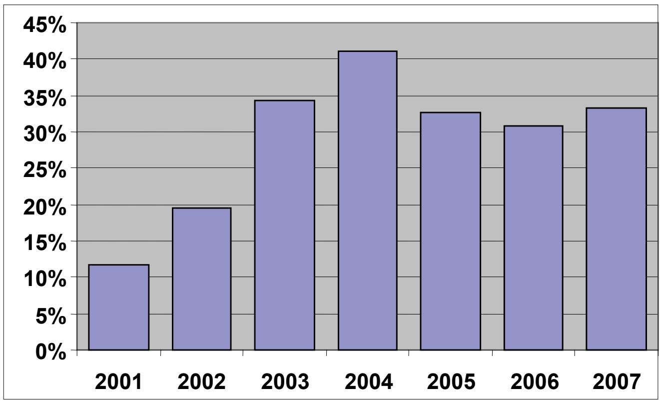
A survey in Canada by Rowlands *et al.* (2003) found that 94% of respondents was prepared to pay at least CAD 5 per month extra for 'green' electricity; 73% at least CAD 10; 29% at least CAD 25 and 5% CAD 50. Assuming again an average consumption of 5000 kWh per year, the latter figure would imply that 5% would be prepared to pay a price premium of EUR 0.08 per kWh.

A Swedish survey by Hansla *et al.* (2008) found that a large majority (81.5%) of the sample was willing to pay at least an additional SEK 0.01 (≈ EUR 0.001) per kWh for green electricty and about 11% SEK 0.10 (EUR 0.01) or more.

This suggests that renewable energy can be considered as a conspicuous good (luxury good) with a high price elasticity of demand and unlikely to be as inelastic as energy as a whole. Therefore relatively small price changes may result in a relatively big switch to renewable electricity. Looking at the market penetration of green electricity in the Netherlands from 2001-2007 provides some evidence for this effect.

In the Netherlands, green produced electricity was exempted from energy tax between 1 July 2001 and 1 January 2004 (€ct 6.54 per kWh). This bridged the difference in production costs in the liberalised electricity market for households in the Netherlands in 2001. Green electricity became as expensive or even cheaper than electricity from coal, gas or nuclear. This resulted in a sudden increase market share of green electricity, as shown in Figure 6.2 below. In 2004, over 40% of households (3 million) used green electricity.

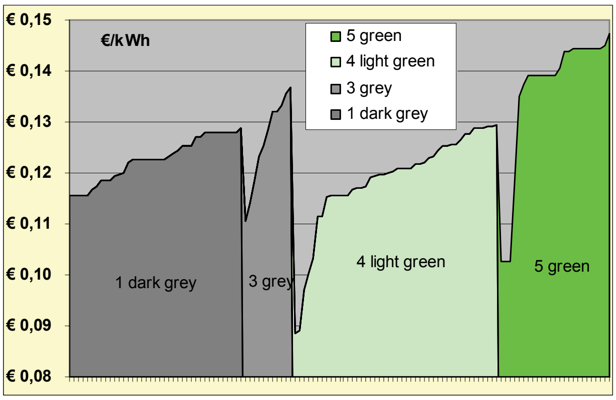
Figure 6.2: Market share of green electricity (households) in the Netherlands, 2001-2007



Source: Tegenstroom, "Ontwikkeling groene stroom klanten" (Develeopment customers of green Electricity), http://www.tegenstroom.nl/node/310

In 2004 the energy tax exemption on green electricity was removed. This resulted in a 10% drop in market share to just above 30% in 2005. However, many households still continued to use green electricity even though consumers are free to change energy suppliers, and can compare electricity prices on the internet (eg. www.energieprijzen.nl). Without any other form of price incentive the share of green electricity has remained constant. Electricity prices in Netherlands differentiated by their source are given in Figure 6.3 below.

Figure 6.3. Differentiation of electricity price (excluding taxes and network costs) for households in South Holland, the Netherlands, from 121 offers (of 18 suppliers) (2 May 2008).



Source: Energieprijzen.nl, "Prices of Electricity in the Netherlands, 121 offers on website"

"Light green" electricity (mainly biomass and hydropower) is on average the cheapest option: €ct 11.9 per kWh, and also has the lowest recorded offer of €ct 8.9 per kWh. "Dark grey" electricity (mainly coal and nuclear) costs on average € 12.3 per kWh, but can be found for €ct 11.6 per kWh. "Green" electricity (wind and solar) costs on average €ct 13.6 per kWh, but is also offered for €ct 10.3 per kWh.

Thus, currently green electricity prices are not very different from non-green prices which has meant that the market share of green electricity has remained at around 35%.

6.3.3 Producers' and suppliers' response to increases in demand for 'green' electricity

Experience with various types of policies to promote electricity from renewables has shown that stability and predictability are major success factors (see e.g. IEA, 2004). Investments in renewables-based generation capacity will only take place if there is a prospect of continuity in demand. This implies the need for guarantees that the policies stimulating that demand will remain in place at least for some time. That will hold for VAT reduction as much as for any other type of instrument.

Liberalisation of electricity markets provides new opportunities for independent power producers supplying 'green' electricity. It also gives electricity suppliers opportunities to adopt a market strategy of product differentiation, offering different kinds of 'green' electricity to their customers (including expensive, 'dark green' varieties). However, the market for 'green' electricity is a typical 'niche market' (see e.g. Van Dijk *et al.*, 2004, Chapter 4). For most customers, electricity is a low-interest, 'bulk' product, implying that price competition is likely to be the main strategy for the largest part of the electricity market.[37] This means that most investments in renewable power generation resulting from VAT reduction will take place in relatively ‘cheap’ technologies (with production costs not exceeding those of non-renewable alternatives by more than 10% or so).

Some helpful insights from a supplier of green electricity in Germany are given in Box 6.1 below.

Box 6.1 Interview with Naturstrom AG (Germany), a supplier of green electricity in Germany

- A reduced VAT rate for green energy tariffs has the potential to increase demand ‘considerably’
- A reduced VAT rate would lower prices for green electricity by approx. 2 cents per kWh, which would lead to a competitive advantage in comparison to conventional suppliers.
- During the initial period (3 months) after the introduction of a reduced VAT rate, most of the economic benefit would be passed through to the consumer. Afterwards, however, increasing demand would require new investments (growth), which cannot be financed by the existing capital stock. Eventually, it is realistic to assume that overtime only half of the VAT cost saving would be passed through to the consumer.
- A reference was made to a situation at the end of 2007, when Naturstrom AG was for a short time the cheapest supplier of green electricity in Germany and even underpriced some conventional suppliers. The applications from new customers increased from 300 to 1000 per day. In this context, the internet is an important medium for people to compare prices. This also implies that consumers are motivated by the cheapest tariff irrespective of green credentials.
- Currently, the supply of green electricity in Europe exceeds the demand by a multiple. Thus, there is currently an over-supply. This would certainly change with a tax relief. Naturstrom AG felt that this was desirable. A new financial incentive would emerge for the construction of new plants/facilities, because the price level for green electricity would increase due to the tax advantage and the emerging scarcity of supply.
- The reduction in VAT would be a good thing. Differentiated VAT rates should be practicable Europe-wide, as it is the case with all export goods.
- It would encourage greater uptake of renewable energy. Since the electricity market is being controlled by very few oligopolists, Naturstrom AG would prefer fiscal supports.
- It was also felt that it would encourage innovation and R&D as it would complement policies such as the EEG [Renewable Energy Sources Act], which, inter alia, has led to a situation where German companies became world-market leaders due to a head start in research. A reduced VAT rate would, in their opinion, also have positive effects, because innovative developments would pay off sooner.
- It would also serve as good communication and sale tool. In Germany, approximately every fifth consumer who switches electricity suppliers switches to green electricity. The demand for green tariff grew rapidly in 2007. However, it is still a niche market, having a market share of approx. 1%. It is not easy to classify customers along socio-demographic lines, although they have an above-average education and income.

[37] There are differences between Member States, however. For example, discount offerings proved to be more appealing to German and Spanish than to British customers because in the

UK customers mistrust cost savings and fear poor services (Kalkman, 2002, cited in Van Dijk *et al.*, 2004)..

7. Case study: Meat and dairy products

7.1 Main factors determining the impact of VAT differentiation

7.1.1 Main characteristics of the product group

Introduction

This case study relates to the VAT treatment of meat and dairy products. It covers meat and dairy products from all farmed livestock (including cattle, sheep, goats, horses, pigs, poultry and other farmed animals). It includes both unprocessed output and products processed for food use (including meat, milk, cheese, cream, butter and yoghurt).

Within the market for meat and dairy products, the case study also considers the differential VAT treatment of organic meat and dairy products. Organic meat and dairy products are those that are certified as meeting organic standards according to the criteria specified in Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products.

Meat and dairy products are used primarily for food. They differ from many of the other goods examined in the case studies in this report in being consumables, with a short lifespan.

Environmental Impacts

According to recent studies of the European Environment Agency (EEA, 2005) and the European Commission (Tukker *et al*., 2005) approximately one third of total environmental impacts from consumers can be related to food and beverage consumption.

Purchasing patterns of consumers are important determinants of the methods employed by the food production industry, which in turn affect environmental impacts throughout the whole food chain (Massari, 2003). Thus, for the evaluation of the environmental impacts of food it is important to consider all the stages of food production and distribution, from the manufacturing and transport of farm inputs to the processing, storage, and dissemination of final products. The most significant environmental impacts occur in general at the beginning of the food product life cycle. At the stage of agricultural production, the meat and dairy sectors involve intensive use of land for grazing and grain production, with impacts on energy and water use; greenhouse gas emissions; water, air and soil quality; landscape and biodiversity.

Within the meat and dairy sector, different production methods give rise to different environmental impacts. While there is some debate regarding the merits of organic compared to conventional products, they offer a variety of potential benefits for the environment, by avoiding the use of synthetic pesticides, fertilisers and GMOs and employing systems compatible with sustainable use of natural resources and high levels of biodiversity. Organic products also offer benefits in terms of enhanced standards of animal welfare, while many consumers prefer them on health grounds (since they are free of pesticides, synthetic fertilisers and GMOs) and for other reasons (e.g. perceptions about taste, quality and links with local systems, culture and traditions).[38]

VAT Treatment of Food in the EU

Foodstuffs are among the goods and services listed under Annex III of the VAT Directive[39] which may be subject to reduced rates of VAT. Category 1 of this list relates to:

Foodstuffs (including beverages but excluding alcoholic beverages) for human and animal consumption; live animals, seeds, plants and ingredients normally intended for use in the preparation of foodstuffs; products normally used to supplement foodstuffs or as a substitute for foodstuffs.

As a result, food is subject to a wide range of VAT rates in different EU Member States (see Table 7.1). The table demonstrates that:

- Most MS apply a reduced VAT rate on food;
- The only MS applying a standard VAT rate on all food products are Bulgaria, Denmark, Estonia, Hungary, Romania and Slovakia;
- Most MS apply more than one VAT rate on food, with many applying more than one reduced rate.

Particularly in the Netherlands and Sweden the potential for reduced VAT rates for organic food has raised attention as a way of reducing consumer prices and stimulating demand. However, attempts to establish this VAT modification in Sweden have failed due to conflicts with EU tax laws (Bellegem *et al*., 2002).

We can conclude that most meat and dairy products are already subject to reduced rates of VAT in most Member States. The only exceptions relate to the six MS which tax food at standard rates, and to certain "luxury" foodstuffs (e.g. ice cream and pre-prepared/catering foods) which may be subject to higher rates in those MS which have reduced rates for most food products.

Given evidence that production of meat and dairy products has particularly high environmental impacts, there are potential environmental benefits from raising VAT rates in order to discourage its consumption. Raising VAT rates to the standard rate in those MS where it is taxed at a reduced rate, while retaining reduced rates on vegetable products, could help to encourage a reduction in the overall footprint of the food sector. Within a differentiated VAT system, it would be possible to encourage organic production by retaining reduced VAT rates on organic meat and dairy products.

[38] O'Donovan and McCarthey (2002) report on the factors influencing consumer demand for organic food in Ireland, finding that health concerns and perceived quality issues are prominent.

[39] Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax.

Table 7.1: Summary of VAT Rates for Food in the EU (Source: European Commission, 2008a)

	Standard Rate (%)	Food Rate (%)	Notes
BE	21	6, 12, 21	
BG	20	20	
CZ	19	5	
DK	25	25	
DE	19	7, 19	
EE	18	18	
EL	19	9	
ES	16	4, 7	Reduced rate of 7% for sales of food, animals and certain types of products for agricultural purposes
FR	19.6	5.5, 19.6	
IE	21	0, 4.8, 13.5	Zero rate for food and drink for human consumption, this excludes soft drinks, ice cream and confectionery.
IT	20	4, 10	Italy imposes a 'super-reduced' VAT rate on food products
CY	15	0, 5, 15	Zero rate for food & drink for human consumption (excl. catering, certain products such as alcoholic and manufactured beverages, ice-cream, chocolate, confectionery, biscuits and savoury products)
LV	18	5, 18	Reduced rate for products for infants only
LT	18	5, 18	
LU	15	3	'Super-reduced' VAT rate on food products.
HU	20	20	
MT	18	0	Some confectionery at 5%. Zero rate for food for human/ animal consumption, except supplies of pre-cooked dishes and highly processed products e.g. ice-cream, chocolates, manufactured beverages or those subject to excise duty, petfoods. Seeds and farm animals also zero rated.
NL	19	6	Reduced rate for most agricultural/food products.
AT	20	10	Reduced rate is applied to food, agricultural inputs.
PL	22	3, 7, 22	
PT	21	5, 12, 21	
RO	19	19	
SI	20	8.5	
SK	19	19	
FI	22	17	
SE	25	12, 25	
UK	17.5	0, 17.5	Zero-rate for food (except "luxury" foods) and nearly all agricultural products (except for horses).

7.1.2 Main characteristics of the market

Market size and growth

The value of agricultural production of livestock and milk amounted to 124 billion euro in 2006, some 39% of total agricultural production of 317 billion euro in the EU27. (European Commission, 2008b) The EU25 produced 45 million tonnes of meat in 2006, of which 48% was pigmeat, 24% poultry and 18% beef. Average consumption per head was 93 kg in that year, including 43 kg of pigmeat, 23 kg of poultry and 18 kg of beef. The figures indicate a slight decline in meat consumption and production between 2004 and 2006. There were 24.3 million dairy cows in the EU27 in 2006, producing 136 million tonnes of milk[40].

The EU is a net importer of beef but a net exporter of pigs and poultry. EU meat consumption per head is more than double the global average of 40 kg. Average consumption varies widely within the EU, and in 2003 ranged from just 52 kg per head in Latvia to 122 kg per head in Spain. Consumption has been static since 1990, with a slight increase in poultry consumption at the expense of beef (European Commission, 2007).

There were 46,000 meat processing enterprises producing meat in the EU25 in 2003, employing 953,000 people, with total turnover of 147 billion euro, and value added of 30 billion euro.

EU-25 milk consumption per capita was 73 kg in 2004, varying from 21 kg per capita in Latvia to 140 kg in Slovenia. The EU is a significant cheese consumer. Per capita consumption of cheese from cows' milk averaged 17.3 kg in 2004, up slightly from 16.5kg in 2000, varying from 3.8 kg per head in Latvia to 28 kg in Greece (DG Enterprise, 2007).

There were 11,377 dairy processors in the EU25 in 2003, with a turnover of 108 billion euro, 388,000 employees, and value added of 17 billion euro. Five EU countries are responsible for nearly 75% of the production value of dairy products in Europe: Germany, France, Italy, the UK and the Netherlands.

According to DG Agriculture (European Commission, 2005), in 2004, the EU market for organic products was estimated at about 11 billion €. Germany was the largest national market in Europe with a share of about 30% of the total EU market volume (3.5 billion €), with the UK, Italy and France also having sales of more than one billion Euro. Organic products accounted for about 1% of total turnover of food products in the EU15 in 2001. However the individual national organic markets are at different stages of development, with the most mature and developed organic markets in Austria, Denmark, Germany, the Netherlands and Sweden. The share of organic production in food sales varies by product group, standing at 1.8% for beef, 1.3% for milk and 1.2% for milk products in 2003. Organic farming accounts for about 4% of the EU's Utilisable Agricultural Area (UAA), with some 6 million hectares certified as organic or in conversion, with more than 60% used for grass or forage production in 2006, primarily for meat and dairy production (Lampkin *et al.,* 2007).

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[40] DG Agriculture data.

Market maturity, penetration rate, saturation

The markets for conventionally produced meat and dairy foods are mature, with only a 2% increase in per capita consumption of meat expected in the EU27 between 2005 and 2014 (DG Agriculture). Consumption of milk and butter are expected to be stable over the same period, with per capita consumption of cheese expected to increase by 12.5%.

The organic food market is an immature market which continues to grow rapidly, and remains a small proportion of the overall food market. Rapid growth was observed in the 1999 to 2002 period in France and the United Kingdom (averaging over 40% per year), Italy and the Netherlands (averaging 20-30% per year) and Germany (15 percent per year). Austria and Denmark are more mature markets with relatively slow growth over the same period. Slower growth rates have been observed over the period 2002-2007, though organic food still accounts for a small proportion of the overall food market and has potential for future growth.

Consumer types, segmentation

Meat is consumed by more than 95% of EU citizens; only a small proportion of the population is vegetarian. Among those who do eat meat, an increasing number are becoming concerned about food quality and safety, as well as the impacts of production on animal welfare and the environment. This is being reflected in increasing sales of organic and free range meat and dairy products.

Main producers, importers, distribution channels

Agriculture is well known to be a highly competitive market, involving many small producers, each with limited influence on the prices at which they can sell their produce.

The meat processing market is competitive, with the top 10 suppliers accounting for between 20% and 30% of the EU market for each type of meat product. Leading players include Danish Crown (Denmark, pigmeat), VION Food Group (Netherlands, pigmeat and beef) Doux (France, poultry) and Irish Food Group (beef) (DG Enterprise, 2007).

The EU has ten of the world's top 20 dairy processing companies, with major players in the EU market being Nestlé (Switzerland), Danone (France), Arla Foods (Denmark, Sweden), Lactalis (France), Unilever (Netherlands/UK), Friesland (Netherlands), Bongrain (France), Campina (Netherlands), Parmalat (Italy), Hermana Milchunion (Germany) and Nordmilch (Germany). These companies vary from commodity processing and marketing firms using large volumes of raw milk, to major, diversified food manufacturing firms (such as Nestle, Danone and Unilever) processing smaller volumes to manufacture higher value added products. Firms with more than 250 employees account for the majority of production.

The concentration of milk processing and distribution among a small number of major firms has led to concerns about abuse of market power in some countries such as the UK, with a recent ruling by the UK Office of Fair Trading finding evidence of collusion among major retailers and food producers in the pricing of dairy products, at the expense of the consumer (BBC News, 2007). The dairy sector is prone to anti-competitive behaviour because of the concentration of the market among a limited number of processors and supermarkets.

The food retail sector is competitive in the EU. While major supermarket chains such as Tesco, Aldi and Carrefour are increasing their market share, consumers continue to demand choice, and there is space in the market for other multiples as well as large numbers of independent food retailers.

For the organic sector, DG Agriculture (European Commission, 2005) estimates that:

- The total number of registered **operators** (producers, processors and importers) in the EU-15 organic food market was about 157 000 which represents an increase of one third compared to 1998.
- The number of registered **organic producers** increased from 100 000 in 1998 to 135 000 in 2003, about 2% of all agricultural producers.
- The number of **organic processors** reached about 25 000 in EU-15 in 2003. The range of processors is wide, from small family-run bakeries to large companies.
- In 2003, there were about 1400 registered **importers** of organic products in EU-15, an increase of 160% compared to 1998.

The importance of individual marketing channels differs among the Member States. In Belgium, Germany, Greece, France Luxembourg, Ireland, Italy, Netherlands and Spain, direct marketing and marketing via specialised shops dominate the organic sector. In Denmark, Finland, Sweden, the United Kingdom, Ireland, Hungary and the Czech Republic, most of the sales are concentrated in supermarkets (>60%) and in non-specialised shops. In Sweden and in Denmark the share of organic food sales through supermarkets is even higher than that of conventional food. Specialists are convinced that where organic products are mainly sold through supermarkets, growth and market shares are (and will remain) higher than in other Member States.[41]

7.1.3 The 'green' product alternative

Criteria for distinction between 'green' and 'non-green'

In this case study we analyse the potential effects of increasing the rate of VAT for meat and dairy products to the standard rate in those MS where it is currently taxed at a reduced rate, in order to reduce the share of meat and dairy products within the overall food market. We also consider the case for retaining reduced rates for organic meat and dairy products, to encourage further growth in the organic food sector.

The standard rate of VAT would be applied to any meat or dairy product, or any processed food product containing a specified percentage of meat or dairy content.

The organic standards provide a clear and unambiguous means of distinguishing between organic and conventionally produced meat and dairy products. Organic produce can be defined as that produced in accordance with the standards set out in the Directive and certified and labeled through a recognised organic assurance scheme.

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[41] Wier and Calverley (2002) provide a review of factors affecting the development of markets for organic foods in Europe, including barriers to growth, concluding that sales infrastructure as well as price premia are important.

Possible complications in applying the criteria

The main definitional issue relating to meat and dairy products relates to the percentage content for a processed food product to be classed as a meat or dairy product. This percentage would need to be specified in the design of the policy. It is not an insignificant problem, particularly as it would be expected to give rise to threshold effects, encouraging producers to reduce content to just below the specified level. This is perhaps less of a problem for meat, where it would be possible to classify any processed good containing meat as a meat product. Dairy products would present more problems, as a large proportion of processed foodstuffs have some dairy content.

For organic, one factor to consider is the varying requirements of different certification schemes. VAT differentiation would need to be based on certification under an approved and recognised scheme, ensuring equal standards are applied to imports as well as domestic production.

Functional differences between the 'green' and 'non-green' products

Meat and dairy products form an important part of the diet of the majority of European consumers, and offer clear differences from vegetable based alternatives in terms of their taste and texture. As a result meat and dairy products are likely to remain an important part of the diet of most consumers, and differentiation of VAT should be seen as a means of encouraging reductions in meat and dairy consumption rather than large scale shifts in dietary habits.

The key functional differences between organically and conventionally produced meat and dairy products relate to the actual and perceived environmental, health, animal welfare, food quality and social benefits of the organic product. However, higher prices for organic products compared with conventional products are a continuing barrier to the development of the organic food market. In this respect VAT differentiation is one possible instrument to decrease the relative prices of organic products and encourage higher consumption of organic food. Expansion of organic meat and dairy production is hindered by high start-up costs, conversion requirements, the high cost of organic feed supplies and difficulties in obtaining organic certification.

Current market share and observed change in recent years

The consumption of meat and dairy products is broadly stable over time, so a VAT induced price change could aim to bring about an absolute reduction in per capita consumption in the EU. The organic sector is developing strongly, but still accounts for only about 2% of EU food consumption, with organic beef and cereals having a higher share than milk and potatoes (EEA, 2005b). Differential VAT treatment could help to encourage its expansion.

Absolute and relative price differences

Because of the complexity of dietary choices and the wide range of potential substitutes available, it is difficult to make direct comparisons of the prices of meat and dairy products and vegetable based alternatives, except in particular cases where there are close substitutes (e.g. butter vs margarine). In general, however, the greater demands of meat and dairy products in terms of land, energy and time mean that prices are higher than for vegetable based alternatives.

Organic food is more expensive to produce than conventional food, and therefore sells at a premium to conventional produce. DG Agriculture (European Commission, 2005) recorded consumer price premia averaging 50% for milk, 81% for pork and 57% for beef in 2002. Very wide variations were observed between Member States. For example, the organic consumer price premium for beef ranged from 4% in Portugal to 126% in Luxembourg. Hamm *et al.* (2002) found the EU average for consumer price premiums in 2000 varied from 31% for organic red table wine up to 113% for organic chicken. Price premiums also varied between different countries, and distribution channels played an important role in this regard. In countries where general food shops were very active in the marketing of organic food, consumer price premiums were usually lower than in countries where organic food shops or direct sales provided the main channels.

7.1.4 Impact of VAT differentiation on product prices

Range of differences between low and high VAT rate among Member States

The VAT treatment of meat and dairy products varies widely between Member States (see Table 7.1). Most Member States have reduced rate VAT on all basic food products, with some having zero rates (UK, Ireland, Cyprus, Malta) and others taxing food at the standard rate (Bulgaria, Denmark, Estonia, Hungary, Romania and Slovakia). As there are also variations in the standard rates of VAT, the differential between the standard rate and that applied to meat and dairy products varies from 0% (Bulgaria, Denmark, Estonia, Hungary, Latvia, Romania and Slovakia) to 21% (Ireland).

Evidence on ‘pass through’ of VAT

The food market is in general a competitive one, with large numbers of producers, processors and retailers. However, there is some concern about the concentration of market power in the dairy sector. In the UK at least, where a few firms account for a large proportion of the milk processing and retail markets, the competition authorities have taken action against price fixing. The Copenhagen Economics (2007) report found that available evidence suggests that there tends to be full pass through of VAT changes in competitive market situations. We would therefore expect a VAT change to be fully passed through to the consumer, and note that it is not in the retailer’s interests to absorb the costs of such a change. However, it should be noted that recent evidence in the dairy sector suggests that prices may not be set competitively and an equivalent pass through cannot be guaranteed. However, consultees considered that full pass through of a VAT change would be expected.

Possible indirect effects on the prices of the ‘non-green’ products

Increasing VAT for meat and dairy products would help to internalise (at least in part) the external costs of their production, which are greater than for vegetable based alternatives. However, it would be expected to meet substantial public and political resistance. It could be seen as a move to interfere with dietary choices and to promote a more vegetarian lifestyle, which would be resisted by many. It might also raise concerns about social impacts by raising taxes on what are seen by many as basic foodstuffs rather than luxury products. Therefore any proposed initiative in this field would need to be accompanied by appropriate impact assessments and measures to raise awareness of environmental objectives.

There is also strong evidence that reducing consumption of meat will have benefits for human health (e.g. Aiking et al, 2006; Gold, 2004). This suggests a need to accompany any change in VAT with a wider programme of activity to enhance understanding of the health as well as environmental benefits of reduced meat and dairy consumption.

Measures to encourage demand for organic produce might be expected to increase imports given the short term constraints on production capacity (and the time lag involved in organic conversion). They would therefore need to be accompanied by measures to augment production capacity.

7.1.5 Impact of price reductions on consumer demand

Relative magnitude of VAT-induced price change

The effect of requiring meat and dairy products to be taxed at the standard rate would be to increase their price by between 0% and 21%, depending on their current VAT treatment in different MS. Predicted price changes are set out in Table 7.2.

Table 7.2: Predicted Price Change from Imposing Standard Rate VAT on Meat and Dairy Products

Price Change	Member States
0%	Bulgaria, Denmark, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia
<5%	Finland
5-10%	Greece, Spain, Austria
10-15%	Belgium, Czech Republic, Germany, France, Luxembourg, Netherlands, Slovenia, Sweden
>15%	Ireland, Italy, Cyprus, Malta, Poland, Portugal, UK

On a simple arithmetic basis, the average price change across MS is estimated at 9%. However, the largest EU markets (Germany, France, UK, Italy) will experience relatively high price changes, and, adjusting for market size produces a weighted average increase in prices of 12% across the EU.

The price of vegetable based foodstuffs will remain unchanged, thus increasing the price of meat and dairy based products compared to vegetable based alternatives.

If VAT on organic meat and dairy products was kept at reduced rates, this would help to reduce the price differential between organic and conventional produce, though the price change would not be large enough to close the substantial premium that persists for most meat and dairy products in most Member States.

Evidence on the role and importance of financial considerations versus non-financial factors

Demand for meat and dairy products is driven by a variety of non-financial as well as financial factors, such as tastes, preferences, lifestyles, health concerns and traditional eating habits, and, for a small but growing proportion of consumers, by social and environmental concerns. These non-financial factors, as well as fixed demands, help to explain why demand for meat and dairy products is price inelastic.

Evidence on impact of targeted price reductions for ‘green’ products

A Dutch study (Bunte *et al.*, 2007) explored the effects of a reduction in the price difference between organic and non organic food. By introducing a temporary subsidy in the form of a “consumer discount”, it was possible to determine whether reducing the price differential of organic products really does lead to higher sales. In the experiment, the prices of eight organic product groups were significantly reduced in most supermarkets in ten communities in the Netherlands in a four month period in 2006, simulating a permanent price reduction. The prices of organic variants of eggs, milk, potatoes, rice and muesli were decreased by 5 to 25% (in steps of 5%). For organically produced pork, minced beef and mushrooms, the prices were reduced by 8 to 40 % (in steps of 8%).

Before the price experiment, the eight organic product groups in the study were on average about 60% more expensive than the conventionally produced product, varying from 9% for rice to almost 90% for minced beef. During the price experiment, the organic products cost nearly 35% more on average than the conventional variant. This differed from 9% cheaper for rice to over 60% more expensive for eggs.

Consumers’ awareness of prices adjusted gradually: after the beginning of the price experiment, consumers overestimated the price of the lower priced organic products. This overestimation was smaller at the end of the experiment. With respect to the price reduction, it seems that consumers only adapt their behaviour once their perception of prices has adjusted.

The study found that demand for eggs, minced beef and muesli responded strongly to the price reductions, increasing the overall value of sales of organic products, and indicating elastic demand. For milk, mushrooms, potatoes, pork and rice, price reductions resulted in an increase in the volume of products bought, but a decline in sales revenue, indicating that demand is inelastic. The study concluded that price reductions can help to achieve policy goals to expand organic consumption, but need to be accompanied by additional measures.

Evidence on the share of ‘free riders’

The free riding problem relates to VAT reductions, and would not be an issue for an increase in VAT to standard rates. As far as a reduced rate for organic meat and dairy is concerned, the ‘free riders’ will be the consumers who currently already buy these products in those countries that currently apply the standard VAT rate and that would start to apply the reduced rate on organic products. Given the small share of organic food products in current demand (abot 2% EU-wide; see section 7.1.3), the number of ‘free riders’ is likely to be limited.

Data on relevant (cross) price elasticities of demand

There is a significant body of published evidence on the demand for meat, dairy and other food products. Annex 7.A provides a statistical review.

The evidence indicates that:

- There is a range of estimates for price elasticities for meat and dairy products;
- Most evidence indicates that the elasticity of demand for both groups is in the range 0 to -1 (i.e. inelastic);
- There is some evidence that demand is more responsive to price changes in the lower income MS of the EU;
- Overall, evidence suggests price elasticities in the range of -0.2 to -0.4 for dairy products and -0.2 to -0.6 for meat;
- Given the wide range of foodstuffs available, no useful evidence could be found on cross price elasticities of demand.

As we might expect, the demand for more specific product groups (e.g. minced beef, pork) which have more substitutes, is more elastic. For this analysis, we are concerned with the elasticity of demand for the product group as a whole.

7.1.6 Environmental impact of changes in consumer demand

Average environmental impact of the 'green' and the 'non-green' products

"*Livestock are one of the most significant contributors to today's most serious environmental problems,*"

Henning Steinfield, senior UN Food and Agriculture Organization (FAO) official (UN, 2006)

"A kilogram of beef is responsible for more greenhouse gas emissions and other pollution than driving for 3 hours while leaving all the lights on back home."

New Scientist (Fanelli, 2007)

Evidence of the environmental impacts of meat and dairy production has been reviewed from a variety of sources (FAO, 2006; Tukker *et al*., 2006; Garnett, 2007; Eshel and Martin; 2006; Gold, 2004; Foster *et al*., 2006 and Williams *et al*., 2006). A summary is provided as Annex 7.A2.

Reducing the consumption of meat and dairy products in the EU can be expected to yield significant environmental benefits in terms of:

1. Reduced GHG emissions. It has been estimated that meat and dairy consumption accounts for 18% of global emissions, especially through the energy involved in rearing livestock and the emissions from livestock and their wastes, with a particular impact through highly potent GHGs such as nitrous oxides and methane. It has been estimated that livestock contribute more to global warming than the transport sector

globally (FAO, 2006). A variety of estimates are available for Europe (e.g. 8% of UK emissions and up to 30% of overall EU emissions if all stages of the food chain are considered; Garnett, 2007; Tukker *et al.,* 2006).
2. Reduced pressure on land use, with livestock production estimated to account for 30% of the earth's land surface directly, and relying on a further 33% of arable land to produce feed. Increasing livestock production is a major driver of deforestation, especially in Latin America where 70% of former Amazon forests have been turned over to grazing (FAO, 2006).
3. Increased resource efficiency, with production of livestock requiring significantly higher levels of energy, land and other resources than vegetable based alternatives, per unit of food produced.
4. Reduced damage to water resources, through pollution from animal wastes, antibiotics and hormones, chemicals from tanneries, fertilisers and the pesticides used to spray feed crops. In particular, livestock farming is a major cause of eutrophication in the EU.
5. Reductions in acidification, with ammonia in particular a major cause of acid rain.

Evidence suggests that GHG emissions per tonne of food produced range from 1.1 tonnes CO_2 equivalent for milk to 4.6 tonnes for poultry, 6.4 tonnes for pigmeat, 15.8 tonnes for beef and 17.5 tonnes for lamb, based on UK data. Evidence suggests that emissions for vegetable based alternatives are much lower than this, though direct comparisons are difficult because of the variety of different crop types involved and uncertainties about the effects of changes in meat consumption on dietary choices.

It is important to note, however, that livestock farming plays an important role in the management of environmentally important landscapes and habitats such as meadows and moorlands. A cessation of livestock production would therefore be environmentally damaging. These areas are, however, often unsuitable for crop production. If a reduction in meat consumption encouraged substitution of intensive livestock production for arable systems it could have significant environmental benefits. The concern would be if a VAT change impacted negatively on some marginal producers, e.g. in upland or dryland areas. Here we can note the presence of other EU interventions such as agri-environment and Less Favoured Areas (LFA) support in encouraging maintenance of high natural value systems.

Organic farming has been proven to have a wide range of benefits compared to conventional systems in terms of reductions in eutrophication and improvements in landscape and biodiversity, and its expansion is encouraged by EU policy. However, evidence suggests that there is no net reduction in greenhouse gas emissions per tonne of organic meat and dairy products.

Evidence on changes in consumer behaviour

One possible concern would be the effect that a VAT induced price change might have in switching demand between different types of meat products. As many consumers would be reluctant to reduce their consumption of meat overall, a VAT induced price change might encourage them to switch to cheaper types or cuts of meat. This could raise concerns in terms of animal welfare, favouring intensive pigs and poultry systems. However, there may be benefits in terms of GHG emissions, as evidence suggests that these systems emit less per kg of product than the production of more expensive beef and lamb.

7.1.7 Impact on innovations

The food market is an established one, and rates of innovation tend to be low. The main issue relates to the ability of consumers, food processors and the food service sector to develop meat and dairy free alternatives to traditional diets.

7.2 Assessing the impact of VAT differentiation

7.2.1 Quantitative assessment

Expected Change in Demand

If VAT on meat and dairy products were raised to the standard rate in all MS of the EU, we would expect this to result in a 12% increase in the average price of meat and dairy products.

Evidence suggests that the overall price elasticity of demand is expected to be in the range of -0.2 to -0.4 for dairy products and -0.2 to -0.6 for meat.

Based on these elasticities, a 12% price increase would be expected to reduce demand for meat in the EU between 2% and 7%, and for dairy products between 2% and 5% (Table 7.3). Based on current consumption levels of 45 million tonnes of meat and 135 million tonnes of milk per year, this would involve an overall reduction of consumption of meat products of between 1.1 and 3.2 million tonnes, and dairy products of between 3.2 and 6.5 million tonnes (measured in terms of liquid milk).

Table 7.3: Expected Impact of VAT Increase on Demand

	Low Elasticity		Medium Elasticity		High Elasticity	
	Mt	%	Mt	%	Mt	%
Meat	-1.08	-2.4%	-2.16	-4.8%	-3.24	-7.2%
Dairy Products	-3.24	-2.4%	-4.86	-3.6%	-6.48	-4.8%

EU evidence suggests a cross price elasticity somewhere between 0.5 and 1.3 for organic meat and dairy products; i.e. a 1% increase in the price of the conventional product increases demand for the organic product by 0.5 to 1.3%. On this basis a 12% increase in the price of conventional produce could boost demand for organic meat and dairy products by between 6% and 16%.

Expected Change in Environmental Impacts

The expected reductions in the demand for meat and dairy products will have benefits in terms of reduced greenhouse gas emissions, reductions in eutrophication and acidification, and reduced pressure on land use.

Based on the estimated greenhouse gas emissions per unit of output given in section 7.1.6 above, we can estimate the gross effects on greenhouse gas emissions as follows (Table 7.4)

Table 7.4: Estimated Impact of VAT Change on Greenhouse Gas Emissions

	Million tonnes CO_2 equivalent		
	Low Elasticity	Medium Elasticity	High Elasticity
Meat	-9.16	-18.31	-27.47
Dairy	-3.43	-5.15	-6.87

It is estimated that the VAT change could bring about a gross reduction in greenhouse gas emissions of between 9.2 and 27.5 million tonnes CO_2 equivalent for meat and between 3.4 and 6.9 million tonnes CO_2 equivalent for dairy products.

The net effects cannot be estimated without assessing the overall impacts on dietary choices and the extent to which meat and dairy products are substituted by other types of foods of different types. However, most vegetable based alternatives will be much less carbon intensive, and it is likely that the net effect will be some 50-90% of the gross effect. On the medium elasticity scenario, this suggests that imposing standard rate VAT on meat and dairy products could reduce greenhouse gas emissions by between 12 and 21 million tonnes CO_2 equivalent per year.

If organic meat and dairy products continued to be taxed at the reduced rate, we estimate that demand could increase by between 6% and 16%. This would not be expected to reduce GHG emissions but could bring a variety of benefits in terms of biodiversity, landscape and reductions in water pollution.

Impact on VAT Revenues

By increasing VAT to the standard rate, the change would significantly raise VAT receipts. The total value of the market is estimated at €191 billion for meat and €122 billion for dairy products in the EU in 2006 (Confederation of the Food and Drink Industries in the EU, 2007). An increase in VAT to standard rates would be expected to yield additional VAT revenues of around €14 billion per year for dairy products and €21 billion per year for meat, after allowing for reductions in demand. If organic produce continued to enjoy reduced VAT rates, this would lower the tax take by about 2%.

Compliance and Administrative Costs

The change being examined would not involve the creation of new VAT rates, but merely raise VAT on meat and dairy products to the standard rate. There might be some cost and effort involved in communicating, understanding and adjusting to the change, but this is not expected to be significant.

7.2.2 Qualitative assessment

Changes in intra-EU trade due to different VAT rates

Raising VAT on meat and dairy products to the standard rate would be a VAT harmonising measure, reducing current distortions. Though the regularity of food purchases means that few consumers are likely to cross borders as part of their general shopping habits, some may be tempted to do so, such as those living on the border of Denmark and Germany where food is currently taxed at 25% and 7% respectively. Raising VAT to standard rates would reduce such incentives.

The 'signalling effect' on producers and consumers

A higher VAT rate, coupled with an education and awareness raising campaign to highlight the environmental and health benefits of eating less meat, could have a significant impact in encouraging consumers to rethink their dietary choices. Since demand is known to be price inelastic, the symbolic effect of a VAT increase could be as important as the price effect.

Other impacts

A VAT change could be expected to have a range of wider impacts, both positive and negative:

- Health Impacts – By encouraging reductions in meat and dairy products, the overconsumption of which is widely recognised as contributing to obesity and other aspects of ill health, a VAT change could yield health benefits, particularly if accompanied by educational activity;
- Consumer Impacts – A VAT increase would be seen as regressive, impacting disproportionately on low income households. Consultees told us that they expected lower income consumers to have difficulty in adjusting their diet in response to a price change;
- Impacts on Farming Sector - A VAT increase would reduce demand for milk and livestock production and be unpopular with farmers, many of whom are already struggling to compete in a more competitive market place;
- Political Factors – There would be strong political resistance to a VAT increase, on the grounds that it is taxing basic needs and amounts to government interference in the dietary and lifestyle choices of individual consumers, as well as the other factors identified above.

Retaining reduced rates on organic meat and dairy products could have further benefits – organic food is perceived as more healthy, is more likely to respect local cultures and traditions, and tends to be more intensive in its use of labour inputs.

7.3 Discussion and conclusions

There is strong evidence that the meat and dairy sector, and livestock farming in particular, is a major contributor to global warming and a variety of other environmental impacts, and that reducing our consumption of meat and dairy products could yield significant environmental benefits. This is a particular priority given growth in global consumption patterns worldwide, which threaten to exacerbate these impacts.

Meat and dairy products enjoy reduced or zero rates of VAT in many EU member states, and increasing VAT to the standard rate on these products offers an opportunity to reduce the environmental impacts of the sector. The scope to reduce consumption of meat and dairy products is limited by their inelastic demand. Nevertheless, we estimate that imposition of VAT at standard rates could help to reduce demand, bringing substantial environmental benefits. For example, it could result in a reduction of greenhouse gas emissions by between 12 and 21 million tonnes CO_2 equivalent per annum.

Any such move should be accompanied by a wider awareness raising and educational campaign, promoting the health as well as the environmental benefits of consuming less meat. Given low consumer awareness of the issue, it is likely that the VAT change will be as important in its signalling effect as in its price effect.

This VAT change would also generate significant revenue and represent a tax harmonising measure (though it would introduce differences in VAT treatment of meat and other food products).

However, despite the expected environmental and health benefits, an increase in VAT on meat and dairy products could be expected to be highly unpopular and meet with intense political resistance.

Annex 7.A: Price Elasticities of Demand

Meat and Dairy Products

Data on price elasticities are available for 114 countries from the 1996 International Comparison Project (ICP) for nine broad categories of goods and eight subcategories of food. The ICP data are consistent and comparable across a large number of countries (Seale *et al.*, 2003). Table 7.A1 presents the own-price elasticity for European countries for the eight subcategories of food.

Table 7.A1: Unconditional own-price elasticity for food sub-groups, Europe, 1996

	Beverages, tobacco	**Breads, cereals**	**Meat**	**Fish**	**Dairy**	**Fats, oils**	**Fruits, vegetables**	**Other foods**
Austria	-0,327	-0,124	-0,267	-0,294	-0,285	-0,144	-0,210	-0,266
Belgium	-0,343	-0,132	-0,279	-0,308	-0,299	-0,152	-0,220	-0,278
Czech Republic	-0,516	-0,220	-0,410	-0,456	-0,441	-0,243	-0,326	-0,409
Denmark	-0,260	-0,100	-0,212	-0,234	-0,227	-0,116	-0,167	-0,211
Finland	-0,422	-0,176	-0,338	-0,375	-0,363	-0,196	-0,268	-0,337
France	-0,348	-0,129	-0,286	-0,314	-0,305	-0,152	-0,225	-0,285
Germany	-0,325	-0,124	-0,265	-0,292	-0,284	-0,143	-0,209	-0,264
Greece	-0,482	-0,188	-0,392	-0,433	-0,420	-0,216	-0,310	-0,391
Hungary	-0,603	-0,272	-0,466	-0,522	-0,503	-0,293	-0,373	-0,464
Iceland	-0,264	-0,096	-0,216	-0,238	-0,231	-0,114	-0,170	-0,216
Ireland	-0,468	-0,198	-0,373	-0,414	-0,401	-0,219	-0,297	-0,372
Italy	-0,337	-0,129	-0,275	-0,303	-0,294	-0,150	-0,217	-0,274
Latvia	-0,710	-0,327	-0,537	-0,606	-0,582	-0,348	-0,432	-0,536
Lithuania	-0,671	-0,301	-0,521	-0,583	-0,562	-0,325	-0,417	-0,519
Luxembourg	-0,128	-0,032	-0,108	-0,118	-0,115	-0,046	-0,084	-0,108
Netherlands	-0,377	-0,149	-0,306	-0,338	-0,327	-0,170	-0,242	-0,305
Poland	-0,646	-0,292	-0,499	-0,559	-0,539	-0,313	-0,400	-0,498
Portugal	-0,466	-0,176	-0,381	-0,420	-0,408	-0,205	-0,300	-0,380
Slovakia	-0,614	-0,273	-0,480	-0,536	-0,517	-0,296	-0,384	-0,478
Slovenia	-0,525	-0,224	-0,418	-0,464	-0,449	-0,247	-0,332	-0,416
Spain	-0,469	-0,187	-0,380	-0,420	-0,407	-0,213	-0,300	-0,379
Sweden	-0,386	-0,159	-0,310	-0,344	-0,333	-0,178	-0,246	-0,309
Ukraine	-0,795	-0,370	-0,575	-0,655	-0,626	-0,388	-0,466	-0,573
United Kingdom	-0,349	-0,137	-0,284	-0,313	-0,304	-0,157	-0,224	-0,283

Own-price elasticities are calculated at the point where marginal utility is held constant.

Source: ERS/USDA: Data Sets on International Food Consumption Patterns
http://www.ers.usda.gov/data/InternationalFoodDemand/

The data indicate that demand for both meat and dairy products is inelastic, with typical own price elasticities of between -0.2 and -0.4 for both groups in the higher income MS of the EU 15 and between -0.4 and -0.6 in the lower income, new MS.

More detailed and recent data are available for the UK, from the National Food Survey (Lechene, undated), covering the period 1988 to 2000. Own price elasticities are given in Table 7.A2.

Table 7.A2: Own Price Elasticities for Meat and Dairy, UK, 1988 to 2000

	Budget Share (%)	Own Price Elasticity	Confidence Interval (90%)
Milk and cream	1.32	-0.36	-0.15 to -0.56
of which:			
Liquid wholemilk and skimmed milks	0.95	-0.17	0.11 to -0.45
Cheese	0.46	-0.35	-0.1 to -0.60
Carcase meat	1.15	-0.69	-0.43 to -0.96
Other meat and meat products	2.35	-0.52	-0.32 to -0.72

Source: UK National Food Survey, 2000

Table 7.A3: Price and Income Elasticities for Different Meat Products, UK, 1988 to 2000

	Own price elasticity	Budget share	Income elasticity
Beef and Veal	-0.45	0.48	0.25
Mutton and Lamb	-1.29	0.22	0.15
Pork	-0.82	0.23	0.13
Bacon and Ham, Uncooked	-0.78	0.33	0.18
Bacon and Ham, Cooked/Canned	-0.76	0.23	0.22
Poultry, Uncooked	-0.52	0.56	0.16
Poultry, Cooked (not canned)	-0.77	0.15	0.31
Other meat and meat products	-0.26	1.26	0.18

Source: UK National Food Survey, 2000

Own price elasticities are estimated at -0.36 for milk and cream, -0.35 for cheese, -0.69 for carcase meat and -0.52 for other meat and meat products (which account for a larger share of the household budget than carcase meat). The demand for individual types of meat is more price elastic, given the presence of more substitutes, but remains inelastic (absolute value below 1) for all groups except mutton and lamb, with an estimated elasticity of -1.29. Demand for liquid wholemilk is found to be particularly inelastic (-0.17).

Lechene also presents cross price elasticities for broad groups of foods. These are generally found to be low and insignificant for the categories employed in the analysis, and provide no usable results.

Organic Meat and Dairy Products

Bunte et al (2007) review evidence of the own price and cross price elasticities of demand for organic and conventional produce, from previous studies. Evidence for meat and dairy products is summarised in Table 7.A4.

Table 7.A4: Evidence of Elasticity of Demand for Meat and Dairy Products Summarised by Bunte et al (2007)

Paper	Country	Products	Price Elasticities				Expenditure Elasticity	
	Period		Own Price		Cross Price		Organic	Non organic
			Organic	Non organic	Demand organic, price non organic	Demand non organic, price organic		
Dhar and Foltz (2003)	US 1997 – 2002	Milk	-1.4	-1.1	3.2	0.0	0.5	1.0
Glaser-Thompson (2000)	US 1996 – 1999	Whole milk	-3.6	-0.7	8.2	0.2	-5.7	1.1
		Milk 1% Fat	-9.7	-0.9	-5.5	-0.4	-8.6	0.6
		Milk 2% fat	-7.4	-1.3	13.5	0.3	-2.8	1.1
		Non-fat milk	-3.7	-0.8	7.1	0.2	-2.8	0.9
Hanson (2003, 2004)	Denmark 1997-2000	Dairy	-0.5	-0.7	0.5	0.1	-0.0	0.8
Wier and Smed (2000, 2001)	Denmark 1997-1998	Dairy	-2.3	-1.1	1.3	0.1	n.a.	n.a.
		Meat	-2.3	-1.0	1.3	0.0	n.a.	n.a.
Bunte et al (2007)	Netherlands	Milk	-1.78	-1.02	0.44	0.03	n.a.	n.a.
		Minced beef	-2.02	-1.04	0.92	0.05	n.a.	n.a.
		Pork	-1.01	-1.01	-0.02	0.00	n.a.	n.a.

The own price elasticity of demand for organic food indicates the percentage change in demand for organic food if the price of organic food rises by 1%, and is expected to be negative. The cross price elasticity of demand for organic food indicates the percentage change in demand for organic food if the price of non-organic food rises by 1%. We expect this reaction to be positive. The expenditure elasticity of demand for organic food indicates the percentage change in demand for organic food if the food budget rises by 1%, and is expected to be positive and higher than for non-organic food, since organic food is a luxury (expensive) product.

The figures indicate that:

- The own price elasticities of demand are negative for both organic and non-organic food, while the demand for organic food tends to be more elastic.
- The cross price elasticities of demand are positive for both organic and non-organic food with the exception of 1% milk. The cross price elasticity for organic food is higher than the cross price elasticity for non-organic food – as we might expect the demand for organic food is more sensitive to the price of non-organic food than vice versa.
- The expenditure elasticities of demand are positive with the exception of the ones for organic products reported by Glaser and Thompson (2000). The latter result is an artefact of the fact that organic milk has a very small market share in the US. What is striking with respect to the expenditure elasticities is the fact that the elasticity for organic food is not higher than the one for non-organic food. Apparently, non-organic food is not really considered as a luxury the demand for which rises with income.

Bunte *et al*. (2007) produced similar findings in their own study, although the cross price elasticity for organic pork was not as expected, primarily because of the budget effect. Demand for organic pork was found to be insensitive to changes in the prices of organic and conventional pork. In particular, the own price elasticities of demand are extremely low.

Bunte *et al*. also report findings by Thompson and Kidwell (2000) that illustrate that the demand for organic food becomes less price sensitive through time because the budget share of organic food rises. The absolute value of the price elasticity of demand falls with an increase in the market share of organic food. Consumers are sensitive for price differences when demand is low and the price gap is high and vice versa.

The authors conclude that the demand for organic products is sensitive to changes in the prices of organic products. One may enhance sales of organic products somewhat by reducing the prices of organic products. However, there is a ceiling to the possibility to enhance sales of organic products. When prices of organic products drop too far, sales revenue actually falls because demand becomes price inelastic, insensitive to price changes. These price levels were reached in the authors' price experiment, with this finding holding in particular for organic milk and pork but not minced beef. The authors found that sales of organic products may also be enhanced, albeit slightly, by raising the prices of conventional products.

Conclusions

The evidence above indicates that:

- There is a range of estimates for price elasticities for meat and dairy products;
- Most evidence indicates that the elasticity of demand for both groups is in the range 0 to -1 (i.e. inelastic);
- There is some evidence that demand is more responsive to price changes in the lower income MS of the EU;

- Overall, EU evidence suggests that price elasticities are in the range of -0.2 to -0.4 for dairy products and -0.2 to -0.6 for meat;
- EU evidence suggests a cross price elasticity somewhere between 0.5 and 1.3 for organic meat and dairy products; i.e. a 1% increase in the price of the conventional product increases demand for the organic product by 0.5 to 1.3%;
- As we might expect, the demand for more specific product groups (e.g. minced beef, pork) which have more substitutes, is more elastic;
- Given the wide range of foodstuffs available, no useful evidence could be found on cross elasticities of demand.

Annex 7.B : Environmental Impact of Meat and Dairy Consumption

The impact of livestock on the environment globally is addressed by a detailed review by the UN Food and Agricultural Organisation (FAO, Steinfield *et al.*, 2006). The report concludes that the livestock sector is a major stressor on many ecosystems and on the planet as a whole. Globally, it is one of the largest sources of greenhouse gases and one of the leading causal factors in the loss of biodiversity, while in developed and emerging countries it is perhaps the leading cause of water pollution. For example, the sector:

- Accounts for 18% of global GHG emissions, including 9% of CO_2, 65% of nitrous oxide, 37% of methane and 64% per cent of ammonia (which contributes significantly to acid rain);
- Contributes more to global warming than the transport sector;
- Uses 30% of the earth's land surface, mostly permanent pasture but also 33% of arable land used to produce feed. It is a major driver of deforestation, especially in Latin America where 70% of former Amazon forests have been turned over to grazing;
- Causes wide-scale land degradation, with about 20% of pastures considered degraded through overgrazing, compaction and erosion;
- Damages water resources, through pollution from animal wastes, antibiotics and hormones, chemicals from tanneries, fertilisers and the pesticides used to spray feed crops;
- Is expanding globally, with production set to double between 2000 and 2050, exacerbating these impacts.

One of the most comprehensive studies carried out at the European level is EIPRO (Environmental Impacts of Products; Tukker *et al.*, 2005), which compares the environmental impacts of different product groups on a life cycle basis. EIPRO shows that the consumption domain 'food and non-alcoholic beverages' ranks first in terms of environmental impacts with regard to almost all environmental indicators[42] and is – in aggregate – responsible for more than 31% of total environmental impacts of EU25 consumption. Food is therefore one of the three 'hot spot' sectors, alongside housing and trans-

[42] The environmental indicators covered by EIPRO are: abiotic resource depletion, global warming, ozone layer depletion, human toxicity, ecotoxicity, acidification, photochemical oxidation and eutrophication.

port (see also Spangenberg and Lorek, 2002). Food products have particularly high impacts with regard to eutrophication (58% of total impacts), eco-toxicity (31%), and global warming and acidification (29% each)[43]. Within the category of 'food and non-alcoholic beverages', the product groups meat and milk products were identified as contributing most to total environmental impacts (see Table 7B.1). These product groups make a particularly high contribution to eutrophication and acidification.

Table 7B.1: Aggregated environmental impacts of different food product groups

	CEDA EU25 (Chapter 5)	
CP01-02	[A52] Meat packing plants	5,5%
(Food etc.)	[A54] Poultry slaughtering and processing	3,9%
	[A53] Sausages and other prepared meat products	2,5%
	[A59] Fluid milk	2,4%
	[A56] Natural, processed, and imitation cheese	2,1%
	[A93] Edible fats and oils, n.e.c.	1,3%
	[A86] Bottled and canned soft drinks	0,9%
	[A75] Bread, cake, and related products	0,9%
	[A66] Frozen fruits, fruit juices, and vegetables	0,7%
	[A98] Cigarettes	0,7%
	[A12] Vegetables	0,7%
	[A92] Roasted coffee	0,7%
	[A65] Prepared fresh or frozen fish and seafoods	0,6%
	[A84] Wines, brandy, and brandy spirits	0,6%
	[A57] Dry, condensed, and evaporated dairy produc	0,6%
	[A96] Potato chips and similar snacks	0,5%
	[A10] Fruits	0,5%
	[A81] Candy and other confectionery products	0,5%
	[A69] Cereal breakfast foods	0,5%
	[A2] Poultry and eggs	0,5%
	30 Other categories, total:	4,4%
	Subtotal	31,0%

Source: Tukker *et al.*, 2005.

A US paper by Eshel and Martin (2006) examines the greenhouse gas emissions associated with plant- and animal-based diets, considering both direct and indirect emissions (i.e., CO_2 emissions due to fossil fuel combustion, and methane and nitrous oxide CO_2-equivalent emissions due to animal-based food production). They conclude that a person consuming a mixed diet with the mean American caloric content and composition causes the emissions of 1,485 kg CO_2-equivalent above the emissions associated with consuming the same number of calories, but from plant sources. This difference amounts to over 6% of the total U.S. greenhouse gas emissions. They conclude by briefly addressing the public health safety of plant-based diets, and find no evidence for adverse effects. They also find that dietary choices compare favourably with personal transport choices in terms of their ability to reduce GHG emissions.

A paper by Gold (2004) for Compassion in World Farming draws similar conclusions about the environmental impacts of a Western, meat-based diet, and argues that, with

[43] The environmental impact estimates exclude the effects of storing and preparing meals (e.g. energy requirements for heating, cooling, washing, etc.) and those related to out-of-home consumption (e.g. eating in restaurants or hotels). Including the latter could increase figures for food-related impacts to more than 40% of the total (Friedl *et al.*, 2006).

trends in consumption of livestock products increasing, a shift is required to achieve sustainability. One of the factors contributing to these impacts is the inefficiency of converting vegetable based feeds into meat. Evidence suggests that the number of kilos of feed required per kilo of final meat product are between 2.1 and 3.0 for poultry, 4.0 to 5.5 for pork and around 10 for beef. Direct consumption of vegetables is therefore more efficient and less resource intensive. As a consequence, livestock farming requires more land to produce a unit of food, and the paper presents evidence that useable protein yields per acre range from 20 for beef and 45 for all meat products to 82 for milk, 138 for wheat and 356 for soybeans. The paper also presents evidence of health and animal welfare impacts.

Garnett (2007) in a review of the greenhouse gas emissions from livestock concludes that the UK's consumption of meat and dairy products accounts for some 8% of UK consumption related greenhouse gases (including imports), largely due to significant emissions of methane (CH_4) and nitrous oxide (N_2O). European studies find that meat and dairy products contribute about 31% of overall emissions and half the food greenhouse gas burden, while a report by the Food and Agriculture Organisation puts livestock related greenhouse gases as high as 18% of the world total.

Greenhouse gas emissions from UK production of livestock products are put at 43.1 million tonnes CO_2 equivalent, of which 40.5 million are attributed to livestock production and 2.6 million to off farm impacts.

An alternative approach, based on UK consumption of different meat and dairy products, estimates the impact of overall UK consumption at 60.0 million tonnes. This uses estimates of the impact of different product types as follows:

Table 7B.2: Estimated Greenhouse Gas Emissions from UK Meat and Dairy Sectors

	CO_2 e/tonne	Total consumption (te)	Total tonnes CO_2 equivalent	% of UK emissions
Beef	16	1,086,000	17,376,000	2.3
Pigs	6.4	1,310,000	8,384,000	1.1
Poultry	4.6	1,795,000	8,257,000	1.1
Sheep	17	372,000	6,324,000	0.9
Eggs	5.5	537,000	2,953,500	0.4
Milk and products	1.06	13,361,000	14,162,660	1.9
Total (farm gate)			*57,457,160*	*7.7*
Ex farm gate			2,586,955	0.4
Total			**60,044,155**	**8.0**

Source: Garnett (2007)

The figures used suggest that production of a tonne of milk and dairy products produces an average of 1.1 tonnes of CO_2 equivalent, while production of a tonne of meat generates between 4.6 and 17 tonnes of CO_2 equivalent.

Evidence for whether organic agriculture provides benefits in terms of lower levels of emissions is found to be conflicting; while organic systems use fewer energy inputs they have lower yields and require larger land areas. Therefore while they generate lower emissions per hectare they do not necessarily do so per unit of output.

The figures for CO_2 equivalent per tonne of output were derived by a study for Defra by Cranfield University (Williams et al, 2006). This found the following ratios (Table 7B.3)

Table 7B.3: Comparison of GHG emissions per unit of output (CO_2 equivalent per tonne)

	Conventional	Organic
Bread wheat	0.8	0.8
Oilseed rape	1.7	1.6
Potatoes	0.2	0.2
Tomatoes	9.4	
Beef	15.8	18.2
Pigs	6.4	5.6
Poultry	4.6	6.7
Sheep	17.5	10.1
Eggs	5.5	7
Milk (whole)	1.1	1.2
Milk (per tonne dm)	10.06	12.3

The figures suggest the scope for significant savings in GHG emissions from switching away from the consumption of livestock products and towards vegetable based alternatives, provided these are not energy intensive crops such as tomatoes. However, the scope for direct comparison is limited by the lack of data on direct substitutes to meat.

Reducing the amount of meat consumption is therefore regarded as one key option to decrease the environmental impacts related to food consumption. Another important option is a broad preference for organic products. Many studies[44] support the general view that organic agriculture has lower negative environmental impacts than standard agricultural practices (Box 7B.1).

[44] For a detailed description of studies which deal with environmental impacts of food consumption see Friedl et al. (2006).

Box 7B.1: Environmental Impact of Organic Farming

Jungbluth (2000) estimated that a 1% increase in the share of organic meat products leads to an average decline in overall environmental impacts of about 0.03%;

European studies have reported that organic cropping practices reduced nitrate leaching by up to 50 % compared to conventional practices (Stolze *et al.*, 2000).

Danish assessments estimate that organic conversion reduced nitrogen leaching by an average of 33 kg N per ha compared with averages from conventional farming, with reductions for livestock farming particularly significant (Jørgensen and Kristensen, 2003).

Stolze *et al.* (2000) and Shepherd *et al.* (2003) conclude that organic farming tends to conserve soil fertility and system stability better than conventional farming systems.

CO_2 emissions are 40–60 % lower in organic farming systems than in conventional ones on a per hectare basis, but higher on a per-unit output scale (Stolze et al., 2000).

N_2O emissions per hectare on organic farms tend to be lower than on conventional farms, while N_2O emissions per kg of milk are equal or higher (Stolze et al., 2000

Organic farming provides benefits to landscape and biodiversity, with evidence of a higher diversity of wildlife habitats (Stolze et al., 2000), and greater botanic species-richness and bird abundance (Hole et al, 2005).

Research in the UK concluded that organic dairy cow production utilised only 22 percent of the energy from conventional production, since cows are mainly fed on grass rather than corn silage, grain and soybean cake (MAFF, 2000).

A study from Finland found that the energy consumed by dairy cows was 4,4 gigajoules per 1000 litre of milk produced in organic systems and 6,4 gigajoules in conventional production (Grönroos, 2006)

According to Ziesemer (2007), organic agriculture uses 30 to 50 percent less energy in production than comparable non-organic agriculture, which relies heavily on energy intensive fertilisers, chemicals, and concentrated feed.

Organic systems are also less likely to use other energy intensive production practices such as irrigation, heavy machinery and heated greenhouses.

Znaor *et al.* (2007) estimated that conversion of 100 percent of Croatia's farmland to organic agriculture would result in decreasing energy use to 38 percent of current levels, estimating that fertiliser manufacturing, transport, and application account for 4.6 percent of national energy consumption.

The organic standards offer potential for further reducing environmentally damaging practices, and can pave the way in identifying energy inefficiencies and developing alternative practices to reduce energy consumption in the food system (Ziesemer, 2007).

Conclusions

Reducing the consumption of meat and dairy products in the EU is expected to yield significant environmental benefits in terms of:

1. Reduced GHG emissions. It has been estimated that meat and dairy consumption accounts for 18% of global emissions, especially through the energy involved in rear-

ing livestock and the emissions from livestock and their wastes, with a particular impact through highly potent GHGs such as nitrous oxides and methane. It has been estimated that livestock contribute more to global warming than the transport sector globally. A variety of estimates are available for Europe (e.g. 8% of UK emissions and up to 30% of overall EU emissions if all stages of the food chain are considered).

2. Reduce pressure on land use, with livestock production estimated to account for 30% of the earth's land surface directly, and rely on a further 33% of arable land to produce feed. Increasing livestock production is a major driver of deforestation, especially in Latin America where 70% of former Amazon forests have been turned over to grazing.
3. Increased resource efficiency, with production of livestock requiring significantly higher levels of energy, land and other resources than vegetable based alternatives, per unit of food produced
4. Reduced damage to water resources, through pollution from animal wastes, antibiotics and hormones, chemicals from tanneries, fertilisers and the pesticides used to spray feed crops. In particular, livestock farming is a major cause of eutrophication in the EU.
5. Reductions in acidification, with ammonia in particular a major cause of acid rain.

Evidence suggests that GHG emissions per tonne of food produced range from 1.1 tonnes for milk to 4.6 tonnes for poultry, 6.4 tonnes for pigmeat, 15.8 tonnes for beef and 17.5 tonnes for lamb, based on UK data. Emissions for vegetable based alternatives are much lower than this, though direct comparisons are difficult because of the variety of different crop types involved and uncertainties about the effects of changes in meat consumption on dietary choices.

Organic farming has been proven to have a wide range of benefits compared to conventional systems in terms of reductions in eutrophication and improvements in landscape and biodiversity, and its expansion is encouraged by EU policy. However, evidence suggests that there is no net reduction in greenhouse gas emissions per tonne of organic meat and dairy products.

8. Conclusions

The main question addressed in this study was how three groups of stakeholders (producers/importers, retailers/installers, and consumers) would respond to the introduction of reduced VAT rates for 'greener' products and to the increase of reduced rates on 'non-green' products to the standard rate. The conclusions will therefore focus on each group separately (sections 8.1 - 8.3), although it is obvious that there are numerous interactions between them. Next, the possible environmental impact of VAT differentiation (8.4) and some other considerations (8.5) are discussed.

8.1 Producers and importers

Changes in market share

An obvious result of an effective VAT differentiation will be that current producers of the eligible 'greener' products will see their market share growing at the expense of those who are specialised in supplying the 'less green' ones. The overall impact will to a large extent depend on the ability of the latter to adapt to the new situation and bring qualifying products on the market themselves. Nevertheless, the experience gained by the current 'green' producers is likely to give them a lasting advantage, implying a shift in market share in their favour.

Innovation and eco-efficient product design

Reduced VAT rates for the most eco-efficient products will benefit those who supply these products. They may sell more of such products (if they pass the tax reduction through to the consumer, resulting in a lower sales price) or they may increase their profit margin (if they maintain the same sales price). In either case, they have an interest in bringing products onto the market that meet the criteria for VAT reduction. Their strategy may be limited to 'taking a piece of the pie', but the most innovative firms will also develop new and still 'greener' products, considering the prospect of obtaining a strong market position in the future when the criteria for VAT reduction will be tightened.

Experiences with past and existing financial incentives as well as the information gathered in the case studies tend to confirm that VAT differentiation can be expected to have a significant impact on innovative activity among the producers concerned. VAT reduction can stimulate the innovation dynamics in 'green' product markets, including learning curve effects and Porter-type competitive advantages. In this respect, there are no essential differences between VAT reduction and other instruments that that selectively stimulate demand and supply of 'green' products.

Obviously, VAT reduction will only be one factor among many others influencing a company's product development policy and marketing strategy. Its role will also differ, depending on the type of product and market.

8.2 Retailers and installers

'Pass-through' of VAT reduction

The evidence on the extent to which reduced VAT rates are 'passed through' to the final consumers, and thus lead to proportionally lower product prices, is mixed. The Copenhagen Economics (2007) study concluded that there is a strong tendency towards complete pass-through. On the other hand, the experience with the reduced rate for labour intensive services shows that in some countries, while the beneficiary sectors passed on part of the reduction in VAT immediately, they tended subsequently to increase their consumer prices at a rate higher than inflation. Thus the application of a reduced rate only temporarily curbed the customary price increases.

The case studies in the present report confirmed the generally mixed picture. For example, in the condensing boiler case, doubts were expressed as to whether VAT reduction would actually lead to lower consumer prices. An interviewee on domestic energy expected that, after the introduction of a reduced VAT rate, most of the economic benefit would initially be passed through to the consumer, but capacity constraints would reduce the pass-through rate afterwards, and eventually only half of the VAT cost saving would be passed through to the consumer. On the other hand, in the case studies on white goods and meat and dairy, interviewees generally appeared to expect full pass-through of the VAT differentiation.

The degree of pass through depends on the competitive position in the market concerned. There is likely to be a high degree of pass through in very competitive markets with many buyers and sellers and low producer profit margins. Pricing strategies may also play a role – we would expect prices to be more "sticky" and less sensitive to marginal VAT changes where fixed price rates (rather than continuously changing prices) are prevalent.

Product, service, or both?

In some cases, installation costs make up a substantial part of the purchasing price of a product, especially if installing the product requires skilled labour. The cases considered in this report showed that these costs may be at least as high as the price of the product itself (central heating boilers) or even much higher (insulation materials). If only the product itself were eligible for reduced VAT and not the service of installing it, the price incentive for the consumer would be substantially lower and it would anyway be less 'visible' to the customer. In addition, the installer would need to prepare a 'split invoice', specifying the product delivered at reduced VAT separately from the service.

Reduced VAT as a marketing tool

The traditional 'marketing mix' consists of manipulating the four P's (product, price, place and promotion). Clearly, VAT differentiation is primarily aimed at influencing the price. However, by providing incentives for innovation (see above) it will also affect the product. Promotion is another element in the marketing mix that may contribute to the success of the instrument.

Advertising the 'greenness' of a product will in itself appeal only to a small part of the market. In order to achieve the majority of customers, it will be essential to emphasise other features of the 'greener' product as well. Among these may be the lower price (resulting from the reduced VAT rate) as well as other elements (such as better product quality).

There are some indications that retailers will indeed use the reduced VAT rate as an additional marketing tool to promote 'greener' products. The 'no-VAT' campaign by a UK retailer in spring 2008, which led to a tripling of sales of the most energy efficient 'white goods', is a clear case in point. Other retailers in the 'white goods' case confirmed that they expected that reduced VAT would be used as an argument in advertising. It was even argued that such advertising should be made obligatory. In the insulation materials case, interviewees also pointed at the communicative value of subsidies and tax incentives and stated that the reduced rate of VAT, if not a significant price incentive is definitely a strong sales tool.

Conservatism

In some sectors, conservatism among retailers and installers may be an important obstacle for the market penetration of innovative products. An example is given by the case of central heating boilers, where reluctance among installers to promote the condensing boiler has delayed its diffusion. Obviously, this obstacle is not specific to the instrument of VAT reduction, but it underlines the need for accompanying promotional measures, specifically targeted at retailers and installers.

8.3 Consumers

Elasticity of demand and price responsiveness

To estimate the response to VAT differentiation, own price elasticities can be useful if the discussion relates to an entire category of products. The demand for meat and dairy products, and for domestic energy, is relatively inelastic. This means that a price change of 10% for these products would lead to a change in demand of (much) less than 10%.

As far as the substitution between 'non-green' and 'green' products within a product category is concerned, the relevant elasticity is the 'cross price elasticity', i.e. the increase in demand for a specific product resulting from an increase in the price of its substitute. Unfortunately, information on cross price elasticities between 'green' and 'non-green' products is scarce, and interviewees generally were reluctant to come up with estimates. Empirical evidence on subsidies, premiums and price experiments suggests that for some product groups the cross price elasticity between 'green' and 'non-green' products may be larger than 1, implying that a VAT difference of 10% would cause a shift in market demand of more than 10%, whereas for others it would be less, but still have the expected sign (i.e., a relative price increase for the 'non-green' product leads to an increase in demand for the 'green' product, and vice versa).

In a dynamic market (such as the market for white goods) the use of (cross) price elasticities is hardly relevant, given the fact that the features of the products supplied on the market are changing continuously.

Elasticities have to be applied with caution when trying to predict the impact of price changes on consumer demand. Psychological and other factors play an important role, and similar price changes can lead to different outcomes under different circumstances. Furthermore, asymmetries occur (stronger demand response to price increases than to decreases) and the elasticity may be greater (in absolute value) for large changes than for small ones. Generally speaking, in the long term demand is more price elastic than in the short term.

The responsiveness to changes in price is likely to vary between different types of products and motivations for buying. For some of the products studied in this report (such as white goods), the primary motivation for the purchase may not be driven by environmental concerns, but by functionality (the need for a new refrigerator or washing machine). Nevertheless, the VAT change may be influential in encouraging the choice of a greener product. For other goods – such as thermal insulation products – the choice is not between a green and non-green alternative. Instead, we are concerned with the overall responsiveness of demand to price changes. However, since much evidence suggests that the payback period for insulation products is already short – and that they are already attractive in financial terms – it is arguable whether further marginal price changes will have a great effect. Instead, the challenge is to overcome consumer inertia, suggesting the need for any VAT change to be accompanied by a significant awareness raising campaign

Bridging the price gap?

An important factor determining consumer response is the relative size of the price decrease in relation to the size of the pre-existing price difference between the ‘green’ products (that become eligible to reduced VAT) and the ‘non-green’ substitutes (that do not become eligible). If this difference is less than 10%, the VAT reduction may actually render the ‘green’ product’s price lower than the ‘non-green’ one’s (e.g. in the case of ‘green’ electricity). However, such cases are likely to be exceptional. In many cases, the price gap is considerably larger than 10% (see for instance the case studies on white goods and meat and dairy products).

Purchasing costs versus life cycle costs

Even if the VAT reduction does not bridge the price gap between the ‘green’ and the ‘non-green’ product, it will still have an impact on the overall life cycle costs of the products. In particular, lower prices of energy efficient products will reduce the ‘payback period’ of their (higher) price and thus make them more attractive for consumers. As the case studies on central heating boilers, white goods and insulation materials have shown, this shortening of the payback period can be substantial, and this could be a useful marketing argument to promote the sales of low-VAT goods.

Non-price factors affecting consumer demand

Evidence from literature and from the case studies strongly suggests that financial incentives, in addition to their impact on prices and payback periods, can have a ‘signalling’ effect. This means that even if the VAT differentiation would not completely neutralise the price difference, it could still make some consumers to opt for the ‘greener’ product, by drawing his/her attention to this product and to the fact that it has some 'officially acknowledged' environmentally benign features. For certain product groups (e.g. household appliances) the 'greenest' product types are usually also the most innovative ones and tend to have additional (functional) benefits for the consumer. In those cases, the choice for the 'greenest' version may be largely determined by other factors than price or energy use, although a VAT-induced price reduction may still be the decisive factor for part of the potential buyers.

'Free riders'

In any consumer-oriented financial incentive scheme, the phenomenon of 'free riding' (i.e., consumers cashing in the bonus who would have bought the 'green' product anyway) cannot be avoided. The percentage of 'free riders' can be substantial and this reduces the cost-effectiveness of the scheme. To some extent this can be avoided by making only the 'environmental top of the market' (the 'greenest' 10% or so) eligible. However, due to the dynamics of the market, the percentage of 'free riders' will increase over time (if there is an 'autonomous' trend towards a growth in demand for the 'green' product) unless the criteria are updated frequently.

Differences between Member States

There is a large variety in markets for 'green goods' between the 27 EU Member States. Some of the differences are linked to physical conditions. For example, investing in insulation materials or in a condensing boiler will have a shorter payback period in cold than in moderate climatic conditions. Consumer preferences (including the willingness to pay for the 'green' features of a product) also differ widely between EU Member States. In addition, numerous other (socio-economic, cultural and institutional) factors may play a role, as well as past and present policies promoting 'greener' consumption.

The case studies have confirmed that there is a large spread of market share figures of eco-efficient products among Member States. As a result, the impact of VAT differentiation (and other financial incentives) on the take-up of these products may also show substantial variation. If the VAT differentiation would apply uniformly across the EU, it might stimulate the growth of the 'green' market in some countries, whereas it would be hardly effective (and bring along a lot of 'free riding) in others, where the 'green' market is already largely saturated. This effect could be mitigated by allowing Member States to choose whether or not they want to apply the VAT differentiation for specific product groups. Alternatively, the criteria for reduced VAT eligibility could be differentiated by Member State, though this would add to the complexity of the scheme.

8.4 Environmental impact

In addition to the shift in demand towards the 'greener' products, a number of other factors determine the environmental impact of VAT differentiation.

Relative environmental performance of the 'greener' product

Better environmental performance of the VAT-reduced products is the *raison d'être* of the tax incentive under consideration. The case studies show that VAT differentiation may indeed bring about significant environmental benefits in some product categories. Table 8.1 shows some estimates for greenhouse gas emissions, but there are of course other environmental benefits as well.

Table 8.1:Estimated greenhouse gas emission reductions due to VAT differentiation in selected cases (Mt CO_2 equivalents per year)

Product category	**GHG emission reduction (Mt CO_2-eq. per year)**
Central heating boilers	18
Refrigerators, freezers and washing machines	3
Insulation materials	23 – 36
Domestic energy (applying standard rate)	20
Domestic energy (reduced rate for renewables-based electricity)	3
Meat and dairy (applying standard rate)	12 – 21

For a complete analysis of the environmental improvement by VAT-induced 'greener' purchasing, it is important not only to look at the impact in the use stage of the product (e.g. energy consumption), but also at impacts in other stages of the product's life cycle.[45] Furthermore, the impacts should preferably be calculated on a 'per unit of service' basis, so as to control for differences in quality of performance. Finally, the estimates cannot be simply aggregated, as there are interactions between the product categories (e.g., better insulated dwellings will reduce the additional energy savings that an energy efficient central heating boiler can bring about). Taking these considerations into account would bring some nuance to the above mentioned estimates, which should therefore only be seen as an illustration of the orders of magnitude.

Product use and the 'rebound' effect

The overall environmental impact will also depend on the way in which consumers use the product. Consumers may for example tend to use energy efficient products more often, or in a less energy-conscious way than their less energy-efficient counterparts. Although this 'rebound effect' has been shown to occur, it is usually relatively small and does not offset the energy efficiency gains. The present study has also argued that a possible variant of the 'rebound effect' (total demand for a certain product group growing as a result of the lower VAT rate on the 'greenest' product within the group) is unlikely to occur.

The net environmental impact of buying a new, 'greener' appliance also depends on the question what happens with the 'old', eco-inefficient one. The impact will be more positive if the discarded appliance is scrapped than if it continues to be used (by the same or another user). Obviously, VAT reduction does not provide an incentive for scrapping.

[45] For meat and dairy products, where all of the significant impacts are at the production and distribution, rather than consumption stage, these are already included in the figures in Table 8.1.

8.5 Other considerations

Acceptance

The acceptance of VAT differentiation as an instrument to promote 'greener' products appears to vary widely, not only between different interest groups but also among stakeholders within the same category. A majority of stakeholders consulted in the case studies tends to support reduced VAT rates for 'green' products, if properly designed and accompanied by supporting measures. There seems to be much less support for an increase in VAT rates on domestic energy, meat and dairy products to the standard level (in countries currently applying a reduced rate).

Product group definition and criteria for VAT differentiation

The scope of the VAT differentiation will have to be established by clearly defining the product group(s) to which it will apply. The present study did not reveal any major problems to be expected. In some cases (e.g. food products with a small percentage of meat or dairy) borderline cases might occur.

The distinction between eligible and non-eligible products has to be made on the basis of objective and unambiguous criteria. Eco-labels, energy labels, 'organic' labels (for food products) and other proofs of compliance with international standards (ISO, CEN) are obvious candidates to make this distinction. In many cases, however, the criteria will have to be applied in a dynamic way, so as to keep track of the dynamics of innovation in eco-efficient products. As noted above, applying uniform criteria across the EU will anyway imply that in some Member States the reduced rate applies to a substantial part of the market, and in other Member States only to the 'environmental top' of the market.

Another implication is that products that qualify for a low VAT today might not do so anymore tomorrow, especially in dynamic markets with rapid product innovations. Some market parties fear that this will have unintended effects, for instance if the demand for 'light green' products would shift towards 'non-green' instead of to 'dark green' when the reduced VAT rate ceases to apply to the 'light green' product. However, evidence for this effect is lacking, and in any case this dynamic aspect of the criteria applied is common to all instruments favouring the 'greenest' products on the market.

Administrative and compliance costs

Differentiated VAT rate structures in general imply higher administrative and compliance costs (including e.g. the costs of judicial procedures) than a single rate system. Applying reduced VAT to eco-efficient products would mean that sectors that were used to work with a single rate will be confronted with a multiple rate VAT administration. Tax authorities will see their administrative workload growing as well. In the past, these additional costs have apparently been accepted for (a.o.) social, health and educational reasons. Whether they are also acceptable for environmental reasons is of course a political decision.

Compared to many other subsidy schemes, using the VAT instrument has the advantage that the basic administrative structure is already in place.[46] It is therefore to be expected that the overall administrative costs will be lower than those of alternative support schemes that would have to be newly created.

Public finance aspects

The present study did not include an in-depth analysis of the possible impact of environmentally motivated VAT differentiation on tax revenues and public expenditure. However, a number of findings relating to this aspect are worth mentioning:

- Introducing reduced VAT rates for ‘greener’ products will (if it has the envisaged impact) lead to lower tax revenues. This loss of revenue can be compensated by a relatively small general increase in VAT rates or by other measures (which, in a majority of Member States, might include the application of standard VAT rates to meat and dairy products, and in a number of them also to domestic energy, especially as these are large markets). Obviously, the need for additional tax revenue (or expenditure cuts) will depend on the scope of the VAT reduction scheme and on its impact in terms of shift in market demand towards products with reduced VAT.
- Even though the VAT system is in itself relatively ‘fraud-proof’, differential tax rates may create an incentive for tax evasion. This affects the public budget in two ways: through lower tax revenues and through higher costs of checks and inspections.
- Differences in VAT rates, and in products eligible to reduced VAT rates, between Member States will induce cross-border sales. This phenomenon is limited to regions close to national borders; elsewhere transport costs tend to be prohibitive. It has some impact on national tax revenues, although the impact at the overall EU level may be neutral.

Relationship with other policy instruments

Policy instruments are almost always applied as part of a package. A possible VAT differentiation will be just one among several measures of a sustainable production and consumption policy. Its effectiveness will therefore to a large extent be determined by the other elements of the package. These policies are only partially harmonised at EU level, and this is an additional reason why the impact of environmental VAT differentiation will differ between Member States.

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[46] Tax credits (allowing consumers to deduct part of the purchasing cost of a ‘green’ product from their income tax payment) have a similar advantage. A comparison of VAT reduction and tax credits was beyond the scope of the present study.

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Kieskeurig: database with (a.o.) prices of heating boilers and household appliances in the Netherlands, http://www.kieskeurig.nl/

Milieucentraal: website with (a.o.) information on products, prices, energy and water use and other relevant information, constantly updated. http://www.milieucentraal.nl/

Preissuchmaschine (Germany): website with the possibility to select hundreds of appliances, with information on availability, prices, product characteristics (i.e. energy, water use), www.preissuchmaschine.de.

'Tegenstroom': http://www.tegenstroom.nl/node/310

UK HM Treasury Budget 2008, http://www.hm-treasury.gov.uk/budget/budget_08/bud_bud08_index.cfm

Wholesale Heating: Prices Condensing boilers UK, http://www.wholesaleheating.co.uk/condensing-combi-boilers.html

Persons and organisations contacted / interviewed[47]:

Association of Czech Cellulose and Paper Producers (Mr Josef Zbořil)

Austrian Chamber of Agriculture (Mr Adolf Marksteiner)

Austrian Chamber of Labour, Tax Department (Mr Otto Farny)

Austrian Society for Environment and Technology (Ms Andrea Ebner)

Charles University Center for Environmental Issues (Mr Milan Sčasný and Mr Vojtěch Máca, research group dealing with environmental tax reform)

Czech Ministry of Finances, Department of Excise Duties (Mr Karel Korba and Mr Zdeněk Hrdlička)

Czech Ministry of the Environment (Mr Jaroslav Blažkovec, Department of Economic Instruments and Public Aid, and Ms Jarmila Zimmermannová, Department of Ecological Tax Reform)

BCC (Dutch electric and electronic appliances retailer) (Mr Pieter Otten, manager CSR)

British Energy Efficiency Federation - www.ukace.org (Mr Andrew Warren, Chairman British Energy Efficiency Federation and Director, Association for the Conservation of Energy)

Carbon Trust - http://www.carbontrust.co.uk/default.ct

CECED (Conseil Européen de la Construction d'appareils Domestiques) - www.ceced.org (Mr Luigi Meli, Director General, and Mr Matteo Rambaldi, Government affairs specialist - Environment)

Consumers International – www.consumersinternational.org (Ms Julian Knott)

Eco-social Forum, Austria (Ms Michaela Hickersberger)

Ekowatt (Czech NGO) (Ms Monika Kašparová)

Energy Saving Trust - http://www.energysavingtrust.org.uk/ (Ms Elaine Waterson, Strategy Manager)

European Insulation Manufacturers Association (Eurima) – www.eurima.org (Mr Hubert David)

FCD (Fédération du Commerce et de la Distribution; the French federation of retailers)

FIEC (European Construction Industry Federation) (Mr John William Goodall, Rapporteur, Technical Commission)

GIFAM (Groupement Interprofessionel des Fabricants d'Appareils d'Equipement Ménager; French Member Association of CECED)

HM Treasury and HM Customs and Excise (Ms Nina Percival, International Indirect Tax)

Knauf Insulation, Germany (Mr Ludwig Schaffer, plant manager)

National Insulation Association - http://www.nationalinsulationassociation.org.uk/ (Mr John C. Mason, Head of Policy and Communications)

Naturstrom AG, Germany (Mr Oliver Hummel, Director, NaturStromHandel GmbH, 100% subsidiary of Naturstrom AG)

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47 Several organisations and companies did not respond or were not prepared to answer questions or to provide information. They are not mentioned here.

Soil Association (Ms Sally Williamson, Market Intelligence Officer, and Ms Kathleen Hewlett, Policy Officer)

Sustain – Alliance for Better Food and Farming (Ms Jeanette Longfield, Co-ordinator)

Uneto-VNI, Zoetermeer (Mr. Rob van der Meer)— www.uneto-vni.nl

Universidade Nova de Lisboa., Departamento de Ciências e Engenharia de Ambiente (DCEA), Faculdade de Ciências e Tecnologia

University of Wales, Institute of Rural Sciences (Ms Susanne Padel, Research Associate)

Vlehan, Zoetermeer (Mr. Jeroen de Roos) - www.vlehan.nl

Which? – UK Consumers Association - http://www.which.co.uk (Ms Sue Davies – Principal Food Policy Adviser)

ZAR, Federation of Austrian Cattle Breeders (Mr Franz Sturmlechner and Mr Anton Wagner)